

Northern Goshawk Finding

June 1998

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
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Portland, Oregon 97232-4181

IN REPLY REFER TO:

Memorandum

To: Director, Fish and Wildlife Service, Washington, D.C. (AES/TE)

From: Regional Director, Region 1 *Arnold E. Lamberton*
6-10-98

Subject: Twelve-month Administrative finding on Petition to List the Northern Goshawk in the Contiguous Western United States under the Endangered species Act

Under section 4 of the Endangered Species Act of 1973 (ESA), as amended, within 12 months of receiving a petition that presents substantial information indicating that listing a species as endangered or threatened may be warranted, the U.S. Fish and Wildlife Service (Service) is to make a finding on whether the petitioned listing is warranted, not warranted, or warranted but precluded by other, higher priority listing actions (16 U.S.C. 1533). In an order filed on June 12, 1997, the Federal District Court for Arizona ruled that a 1991 request to list the northern goshawk (*Accipiter gentilis*) in the western United States constituted a petition requiring evaluation under the ESA. On September 22, 1997, the Service found that this petition presented substantial information that listing the northern goshawk in the contiguous United States west of the 100th meridian may be warranted. With your concurrence, this memorandum constitutes the Service's 12 month finding for this petition under the ESA. For the reasons explained below, listing of the northern goshawk in the petitioned area is not warranted.

Background

On July 19, 1991, the Service received a petition from Dr. Robin Silver, M.D., Maricopa Audubon Society, Phoenix, Arizona (Silver et al. 1991), to list the northern goshawk (*Accipiter gentilis*) as an endangered species in Utah, Colorado, New Mexico, and Arizona with critical habitat. On September 26, 1991, a letter was received by the Service from Mr. Charles Babbitt, Maricopa Audubon Society, and a coalition of conservation organizations (Babbitt et al. 1991) requesting to amend the petition already under consideration by the Service. The coalition included the Arizona Audubon council, Southwest New Mexico Audubon Society, Mesilla Valley Audubon Society, Forest Guardians, Friends of the Owls, Greater Gila Biodiversity Project, HawkWatch, Rio Grande Chapter of the Sierra Club, and Southern Utah Wilderness Alliance. The coalition requested expanding the geographic region under consideration to include the "forested west." The forested west was subsequently defined as the forested United States west of the 100th meridian. Because the request to amend the previous petition required

consideration of a listing action substantially broader in scope than the petition under review at that time, the Service informed the coalition that their request for an amendment would be considered as a separate, new petition.

On January 7, 1992, the Service published a finding that the July 1991, petition did not present substantial information to indicate that the goshawk in the petitioned region (Utah, Colorado, New Mexico and Arizona) constituted a listable entity (57 FR 546). However, the Service concluded that the petition presented substantial information indicating that northern goshawk population declines and loss or modification of habitat may be occurring. Therefore, the Service announced in a separate *Federal Register* notice (January 7, 1992; 57 FR 544) the initiation of a status review for the northern goshawk throughout its range in the United States. The January 1992 status review specifically solicited information to evaluate the potential for “distinct population segments” within the range of the northern goshawk in North America.

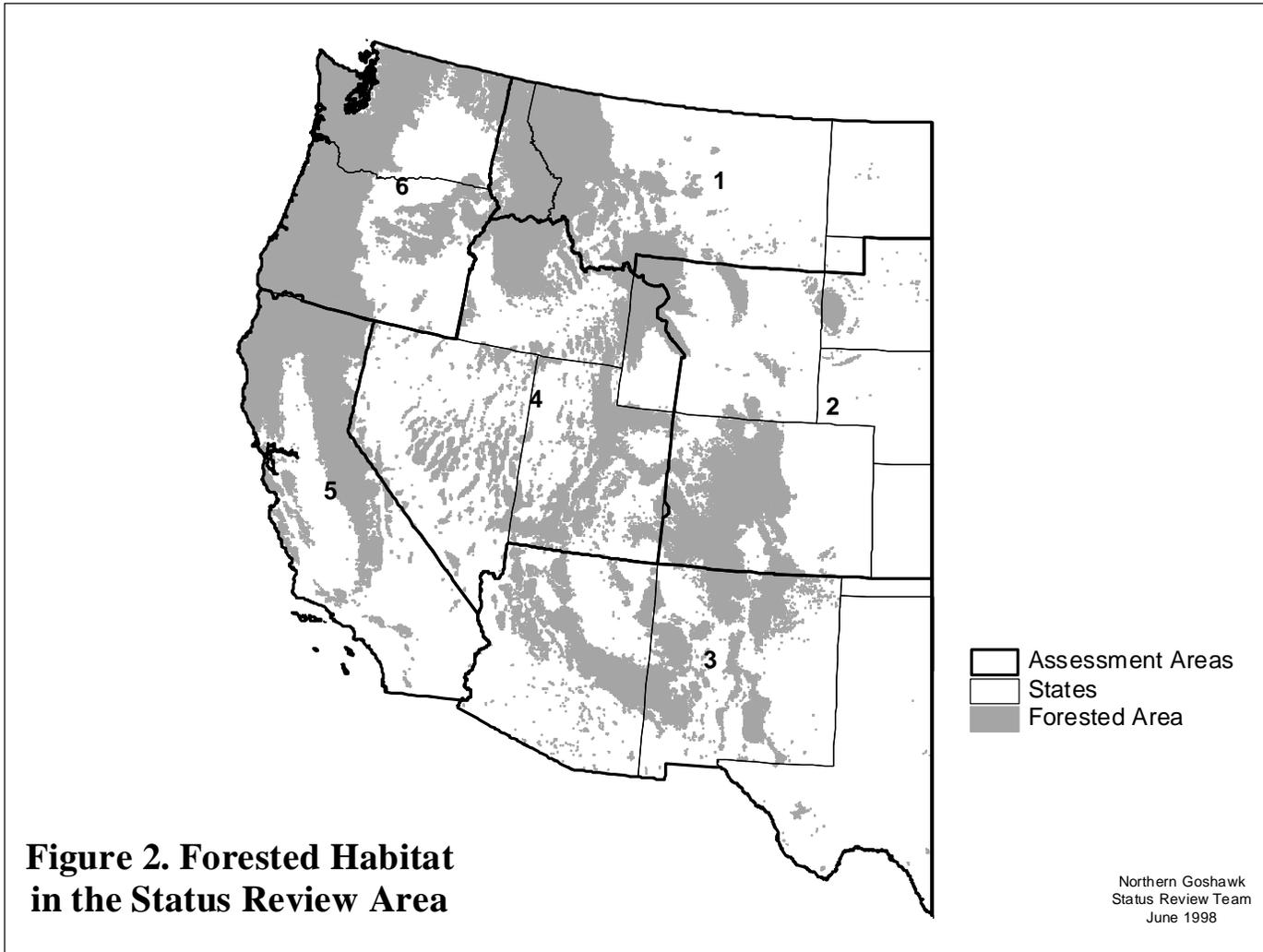
On June 25, 1992 (57 FR 28474), the Service published a 90-day finding that the September 1991, petition did not present substantial information to indicate that the northern goshawk in the western United States was a listable entity. The Service found that the petition presented no evidence of reproductive isolation or genetic differentiation between the goshawk in the west and the goshawk in the eastern United States, and that goshawk habitat was contiguous from the western United States to the eastern United States through Canada. The petitioners subsequently filed suit in Federal District Court in Phoenix, Arizona to have the Service’s finding set aside. On February 22, 1996, United States District Judge Richard M. Bilby found the Service’s June 25, 1992, finding to be arbitrary and capricious and remanded it to the Service for a new 90-day determination.

On June 6, 1996 (61 FR 28834), the Service published a notice vacating the petition finding of June 25, 1992, and published a new 90-day finding that the petition to list the northern goshawk in the western United States had not presented substantial information that the petitioned action may be warranted. The Service determined that since the entity petitioned for listing was comprised of more than one subspecies it did not meet the definition of a distinct vertebrate population segment as defined in the National Marine Fisheries Service and Fish and Wildlife Service Final Policy Regarding the Recognition of Distinct Vertebrate Population Segments under the Endangered Species Act (DPS policy; February 7, 1996; 61 FR 4722).

The petitioners again filed a suit in Federal District Court to have the Service’s June 1996, finding set aside. On June 6, 1997, Judge Bilby found the June 1996, finding to be arbitrary and capricious, and remanded it to the Service for another 90-day finding. On August 19, 1997, Judge Bilby clarified that the decision on remand was to be made using the Service’s DPS policy without the “one subspecies” rule that the Service had relied on in making its June 6, 1996, finding. In addition, on August 22, 1997, the petitioners amended their petition to seek listing of northern goshawks west of the 100th meridian in the contiguous 48 states.

Figure 1. Northern Goshawk Status Review Area
with Assessment Area boundaries





On September 29, 1997, the Service published a 90-day finding (62 FR 50892) that the petition provided substantial information indicating that the listing of the northern goshawk as threatened or endangered in the contiguous United States west of the 100th meridian may be warranted. At that time, the Service initiated a Status Review for the northern goshawk. Figure 1 illustrates the geographic scope of the Status Review area. For purposes of analysis only, the Service's Status Review Team broke the petitioned area into 6 assessment areas; these areas do not reflect potential distinct population segments. Figure 2 illustrates the distribution of forested habitat in the Review Area.

Life History

Description

The northern goshawk is the largest of the three accipiters of North America, possessing short, broad wings and a long, rounded tail. Females are larger than males, with total average length of about 61 centimeters (cm) (24 inches (in)) for females and 55 cm (22 in) for males. The wingspan for females is 105-115 cm (46 in) and for males is 98-104 cm (42 in) (Wood 1938, Squires and Reynolds 1997). Adults are gray above, blackish on the crown and side of head, with a bold, whitish streak over the eye. The underparts are light gray with fine horizontal vermiculations and fine vertical streaks. The tail is dark gray above, with several blackish bands; the tail tip is rounded and usually tipped with a white terminal band. Tail below is lighter gray with fluffy white undertail coverts (Squires and Reynolds 1997). Immatures (Palmer 1988, Johnsgard 1990, and Squires and Reynolds 1997) are a dark brown to brownish-black above with buffy white and cinnamon streaks. The underparts are a buff white, with cinnamon to brown streaking on the throat. The head is brown and usually has a narrow whitish streak over the eye. The dark brown tail has wavy dark brown bands with thin whitish borders that form a zigzag pattern. Undertail coverts are usually streaked, and not fluffy.

Taxonomy

The northern goshawk (*Accipiter gentilis*) was originally described by Linneaus. The northern goshawk is circumpolar in distribution, with two groups recognized worldwide: the palearctic *gentilis* group, consisting of several subspecies (*A. g. gentilis*, Europe to central Russia; *A. g. buteoides*, northern Europe and Asia; *A. g. albidus*, northeastern Siberia to Kamchatka; *A. g. arrigoni*, Sardinia and Corsica; *A. g. schvedowi*, southern Siberia, northern Japan, Chinese Mountains; and *A. g. fujiamae*, Honshu Island), and the nearctic *atricapillus* group consisting of *A. g. atricapillus* (Wilson 1812, type locality Philadelphia, Pennsylvania). The *atricapillus* group occurs over much of Alaska, Canada, and the mountains of the western and eastern United States. In addition to the main *A. g. atricapillus* subspecies, at least two other subspecies are currently, but variously, accepted--*A. g. laingi* (Taverner 1940, type locality Queen Charlotte Islands, British Columbia), and *A. g. apache* van Rossem (van Rossem 1938, type locality Chiricahua Mountains, Arizona), which occurs in the mountains of southeastern Arizona, southwestern New Mexico and northern Mexico (Wattell 1973).

In addition to *apache* and *laingi*, two other subspecies have been described but are no longer

recognized. In 1874, Ridgway (Baird *et al.* 1874) described a western goshawk (*A. g. striatulus*) based on differences in plumages of hawks in the western United States from the more eastern *atricapillus* form. In 1884, Nelson (1884) described *A. g. henshawi* from Lake County, Oregon and Calaveras County, California, on the basis of darker plumages than *atricapillus*.

Taverner, 1940, showed the plumage differences of *striatulus* were associated with age of hawks and that *striatulus* was indistinguishable from *atricapillus*. He described *A. g. laingi* from the coastal islands of British Columbia on the basis of darker plumages, a characteristic of both the adult and juvenile plumages. Taverner (1940) also reported a gradient in plumage darkness from the lighter-colored mainland hawks to intermediate forms on Vancouver Island to the darkest hawks on the Queen Charlotte Islands.

Van Rossem (1938) described the subspecies *A. g. apache* on the basis of longer wing chords and darker colors of six hawks collected in southern Arizona and Sonora and Jalisco in Mexico. The distinguishing characters of *apache*, as defined by van Rossem (1938), are “darker and more blackish (less bluish) dorsally even than *Accipiter gentilis striatulus* (Ridgeway) of the Pacific Northwest, the darkest of two previously described North American races; young with ventral streaking broader and darker than the young of *striatulus* (= *atricapillus*). Size largest among the North American races.” Van Rossem (1938) gives the range of *apache* as “extreme southeastern Arizona (Chiricahua Mountains), south through Sonora (Yecora) to Jalisco (Sierra de Nayarit).”

Recognition of the *apache* subspecies is variable and a subject of current debate. It is recognized by Brown and Amadon (1968), Wattel (1973) and Snyder and Snyder (1991). However, *apache* was excluded from the American Ornithologists’ Union’s (AOU) Check-list of North American Birds 5th edition (1957). Because van Rossem (1938) originally described *apache* based on only 3 specimens, the validity of the subspecies is not accepted by most taxonomists. Hubbard (1992) presented evidence for retaining *apache*, however, the AOU still does not recognize it as a valid subspecies (AOU 1983). The Fish and Wildlife Service acknowledged the existence of *apache* as a subspecies in its 1992 administrative finding relative to the petition to list the northern goshawk. This was based, in part, on erroneous information indicating that *apache* had been recognized by the AOU. The 7th edition of the AOU’s Checklist of North American Birds is due out in mid-1998, and it will not address subspecies. The Service finds that recognition of *apache* as a legitimate subspecies is unresolved, and does not consider it a separate subspecies for purposes of this finding.

The American Ornithologist’s Union recognizes *A. g. laingi* as a relatively smaller, darker subspecies occurring on the Queen Charlotte Islands and Vancouver Island, British Columbia (AOU 1957). Based on comparisons of small numbers of specimens from throughout the region, several subsequent authors have variously hypothesized that the range of this subspecies may extend northward to Baranof Island (Webster 1988) and southward into the Olympic Peninsula (Beebe 1974) and coastal Oregon and Washington (Jewett *et al.* 1953). The conclusion of Jewett *et al.* (1953) was based on description of only two specimens from Oregon and Washington. Based on an assessment of all published accounts, the Service (USDI 1997) defined the probable

range of *A. g. laingi* as Vancouver Island northward through insular British Columbia, insular and adjacent mainland Alaska, to Icy Strait and Lynn Canal (USDI 1997). Whaley and White (1994) concluded that more study is needed to determine the taxonomic status of insular and mainland goshawks in the Pacific Northwest. This subspecies is currently the subject of litigation under a separate petition for listing under the Endangered Species Act and is not further addressed in this action.

Distribution

Northern goshawks are holarctic in distribution, occupying a wide variety of boreal and montane forest habitats throughout the Nearctic and Palearctic (Johnsgard 1990). They breed in North America from western and central Alaska, northern Yukon, eastern and southern Mackenzie, southern Keewatin, northeastern Manitoba, northern Ontario, central and northeastern Quebec, Labrador, and Newfoundland south to southern Alaska, central California, southern Nevada, southeastern Arizona, southern New Mexico, the eastern foothills of the Rockies and the Black Hills, central Alberta, central Saskatchewan, southern Manitoba, northern Minnesota, central Michigan, Pennsylvania, central New York, northwestern Connecticut, and locally south in the montane habitats at least to West Virginia; possibly eastern Tennessee and western North Carolina. Goshawks are local residents in the mountains of northwestern and western Mexico, and are widely distributed in Eurasia (Squires in prep).

The winter range of goshawks includes all of the breeding range in North America, and extends south as far as southern California, northern Mexico and Texas, and occasionally to northern portions of Gulf States, rarely including Florida (Squires in prep).

Available evidence suggests the distribution of goshawks in the northern and western portions of their range is relatively unchanged since settlement by Europeans (Jones 1979). Extensive forest cutting in the eastern U. S. may have reduced eastern goshawk populations, but these populations appear to be recovering as forests in the East recover and mature (Speiser and Bosakowski 1984).

Migration

The existence and extent of migratory behavior is geographically and temporally variable, and appears to be closely tied to food availability. Migration routes are poorly delineated. Information on migration patterns comes primarily from counts at migration stations, band returns, and radio-telemetry. Table 1 summarizes numbers of goshawks seen at seven counting stations in the United States (Squires and Reynolds 1997).

Table 1. Numbers of goshawks sighted at the Goshute Mountains, NV; Wellsville Mountains, UT; Manzano Mountains, NM; Sandia Mountains, NM; Hawk Mountain, PA; Hawk Ridge, MN and Cape May, NJ, during fall migration. (From Squires and Reynolds 1997 and S. Hoffman unpubl. data.)

Year	Goshute Mountains ¹	Wellsville Mountains ¹	Manzano Mountains ¹	Sandia Mountains ¹	Hawk Mountain ²	Hawk Ridge ³	Cape May ⁴
1972					347	5,382	
1973					307	3,566	
1974					61	1,400	
1975					136	312	
1976					62	308	17
1977		31			85	110	22
1978		30			58	166	19
1979		29			68	326	16
1980					83	250	25
1981					138	981	34
1982					140	5,819	35
1983	108				129	1,999	40
1984	122				59	934	25
1985	112		20	19	50	584	75
1986	63		20	14	106	354	24
1987	54	10	6	14	57	203	20
1988	68	14	6	4	50	177	14
1989	74	14	13	6	27	106	9
1990	115	17	3	10	88	626	34
1991	132	12	7	7	54	1,007	55
1992	222	53	16	12	43	2,247	30
1993	107	15	27	24	109	1,393	80
1994	100	15	29	12	31	305	37

¹S. Hoffman, Unpublished data submitted for Status Review, HawkWatch International

²Hawk Mountain Sanctuary Association, unpublished data

³David L. Evans unpublished data, Hawk Ridge Nature Reserve

⁴Cape May Bird Observatory unpublished data

Goshawks in northern areas of their range are known as “irruptive” migrants. Irruptive goshawk migrations occur in the more northern populations and are in response to rapid decreases in snowshoe hare populations. Mueller and Berger (1968, 1977) reported 2 population irruptions based on counts of migrating hawks in Wisconsin. Irruptions occurred at approximately 10-year intervals and coincided with declines in indices of snowshoe hare and ruffed grouse abundance in breeding areas. Similarly, Doyle and Smith (1994) reported that goshawks in southwest Yukon, Canada were year-round residents during years of high snowshoe hare abundance, but left the area during years of low hare abundance. The numbers presented in Table 1 demonstrate the occurrence of migration irruptions, although a portion of goshawks may be locally derived, and counts may therefore partially reflect annual variations in local reproduction (Hoffman 1992).

Migration counts at Hawk Mountain suggest northeastern goshawk populations “irrupt” on a 4-year cycle (Nagy 1975). Migrations generally occur between 17 September and 16 December, and adult males and females migrate simultaneously during irruption years (Mueller and Berger 1968, 1977, Nagy 1975). Juveniles are more mobile than adults (McGowan 1975), and fledglings are believed to migrate first. Adults tend to stay on or near nesting areas except in times of food shortages when irruptive migrations may occur, while juveniles tend to leave nest territories in late summer or fall (Palmer 1988).

Mueller and Berger (1967) summarized band return data from North America through 1965. Sample sizes were too small to draw meaningful conclusions concerning migration patterns. However, only 4 of 35 recoveries of adult birds were more than 2 degrees latitude from their place of banding, which may indicate relatively short distance movements.

Radio-telemetry studies provide information on migration patterns but studies conducted to date have sampled too few years to establish long term patterns. A radio-tagged female in Alaska exhibited fidelity during winter to an area no larger than a typical summer home range (McGowan 1975). A similar observation was made by Kennedy (unpublished data) in New Mexico. Goshawks in Wyoming exhibited short distance migration (range 65 - 185 km)(40 - 115 mi) during the winter of 1992 (Squires and Ruggiero 1995), while limited data from northern Arizona indicate altitudinal migrations of very short distances (< 20 km)(<12.4 mi), (Reynolds *et al.* 1994). Radio-tagged goshawks in Arizona south of the Grand Canyon appeared to be year-round residents (P. Hall, unpublished data).

In summary, the data indicate that goshawks generally are not migratory, except in the northern part of their range where they irrupt irregularly in response to declines in prey populations. Southern populations are more sedentary. Most southern populations are resident year-round in years of moderate to high food availability, but may “wander”, irrupt or exhibit altitudinal migrations when prey populations decline.

Home Range

Goshawks are highly mobile and have large home ranges. In North America, telemetry studies of goshawk movements and habitat-use patterns include Austin 1993, Bright-Smith and Mannan

1994, Hargis *et al.* 1994, Kennedy *et al.* 1994 and Titus *et al.* 1994. The difficulty in monitoring goshawk movements via radio telemetry often results in studies having small sample sizes which reduce the statistical power of habitat-use analyses. Small samples may also underestimate home range size and variation in habitat use exhibited by individuals within populations. Nevertheless, radio-telemetry has provided valuable insights into the foraging and spatial-use patterns of goshawks. Techniques that have been used other than radio telemetry to estimate goshawk home ranges include: 1) repeatedly observing the direction and distance traveled by male goshawks above the forest canopy (Reynolds 1979); 2) assuming the home ranges are circular and assuming one-half the mean distance between nests as the radius of the home range (Reynolds 1983); 3) plotting the locations of marked prey whose remains were found in a goshawk nest (Eng and Gullion 1962); and 4) plotting the locations of molted feathers (Brüll 1964).

In North America, home ranges of nesting goshawks usually range from approximately 500 to 4,000 ha (1,200 - 10,000 ac) depending on sex, habitat characteristics, and field procedures used by researchers. Size comparisons among studies are difficult and may not be meaningful due to differences in methodology. Home ranges of males tend to be larger than those of females (Hargis *et al.* 1994, Kennedy *et al.* 1994), but there are exceptions (Austin 1993). Home ranges of adjacent pairs may overlap, especially in areas where nesting populations are at or near saturation (Reynolds and Joy 1998).

Little is known about the size of winter home ranges of goshawks in North America. On the Shasta-Trinity and Klamath National Forests in the southern Cascades, Austin (1993) found an average home range of 2,425 ha (5,990 ac) for 5 males and 3,774 ha (9,322 ac) for 5 females using radio-telemetry (100percent minimum convex polygon method). In the Lake Tahoe region of the Sierra Nevada, California, Keane and Morrison (1994) found 95% minimum convex polygon home ranges averaged 8,360 ha (12,289 ac) during the nonbreeding season for males and 3,180 ha (4,675 ac) for females.

Habitat Characteristics

Nest Habitat

Vegetation and landform characteristics associated with nest site, or nest area, habitat are one of the best understood aspects of goshawk biology. These characteristics have been described for hawks nesting in the Great Basin (Yonk and Bechard 1994), interior ranges of Oregon (Reynolds *et al.* 1982, Moore and Henny 1983), Cascade Range of California (Saunders 1982), Modoc Plateau and Sierra Nevada of California (McCarthy 1986), Inner Coast Ranges of California (Hall 1984), Cascade Range of north-central California (Allison 1996), eastern Oregon (Daw 1996, Desimone 1997, McGrath 1997), Washington (Fleming 1987, McGrath 1997), northeastern Arizona (Crocker-Bedford and Chaney 1988, Ingraldi and MacVean 1995), New Mexico (Siders and Kennedy 1994), Rocky Mountains of Montana, Idaho (Hayward and Escano 1989), Colorado (Shuster 1980), Wyoming (Squires and Ruggiero 1996), Utah (Hennessy 1978), South Dakota (Bartelt 1977), Pennsylvania (Kimmel and Yahner 1993), New Jersey and New York (Speiser and Bosakowski 1987) and Alaska (McGowan 1975a).

Although goshawk nest habitat has been widely studied, a number of potential biases in studies should be addressed. In some studies, nests were located during preparation of timber-sales which typically occur in older-aged forest stands. In others, observers only searched areas that met their preconceived notion of “suitable” goshawk nest habitat; typically, these areas only included mature and old-growth forests. Thus, knowledge of goshawk choice of nest sites may be biased toward older habitat types (Squires in prep). However, Daw *et al.* (in press) compared habitat characteristics in 0.4 ha areas around 27 nests found systematically and around 22 nests found opportunistically on three national forests in eastern Oregon and found that both density of large trees and canopy closure were similar for nests found with either search method. However, these results do not preclude the fact that bias can be reduced by conducting nest searches in a systematic fashion across all habitats within landscapes.

Forest raptors typically have a wide choice of locations, forest types and forest structures in which to nest. For territorial species like goshawks that prefer a certain forest structure, choice of nest sites may be limited to portions of a landscape not already occupied by other pairs, but that also contain the landscape structure and pattern comprising suitable nest habitat. Given that forest raptors typically have habitat needs that extend beyond their nest areas, their choice of territory may depend on larger scales that provide suitable habitat for foraging and prey.

Movements within territories between years may occur between alternate nests within the same forest stand or in different forest stands (Reynolds and Wight 1978, Woodbridge and Detrich 1994), with some nest areas used for decades (Reynolds and Wight 1978, Gullion 1981, Reynolds *et al.* 1992). In Oregon, Reynolds and Wight (1978) reported that alternate nests were usually 60 to 90 meters (200 - 300 ft) apart, but some were up to 400 meters apart. Reynolds *et al.* (1994) reported a mean distance between alternate nests in northern Arizona of 266 m (1,320 ft). The mean distance for 4 cases where both members of the pair were known was 485 m (1,600 ft). The maximum distances moved between alternate nests by a pair of known birds was 1,316 m (4,316 ft) (Reynolds *et al.*, unpublished data) in northern Arizona and 966 m (3,188 ft) in north - central New Mexico (P. Kennedy, unpublished data). Woodbridge and Detrich (1994) reported a mean distance between alternate nests in northern California of 273 m (893 ft), an estimate they considered conservative because long distance movements were more difficult to detect under their sampling protocol. However, because not all birds were marked, movements between territories could have been confounded with movements between alternate nests.

In the intermountain west, goshawks nest in both deciduous trees such as cottonwoods near stream bottoms (Call 1974) and in either aspens or conifers at upland sites (Shuster 1980, Hayward and Escano 1989, Bokich 1991, Squires and Ruggiero 1996). In Wyoming, 38 % of nests were in aspen (n = 39), 59% in lodgepole pine, and 3% in subalpine fir; aspen and lodgepole pine were used in proportion to their availability while subalpine fir was avoided (Squires and Ruggiero 1996). In the southwestern United States and the Black Hills of South Dakota, goshawks frequently place nests in ponderosa pines (Crocker-Bedford and Chaney 1988, Kennedy 1988, Reynolds *et al.* 1992, Ingraldi and MacVean 1995).

Goshawks in the Pacific coastal states typically nest in conifers. In eastern Oregon, 41 nests were located in ponderosa pine, 14 in Douglas-fir, and 6 in white fir; the remaining 8 nests were in either lodgepole pine, western larch, quaking aspen, or western hemlock (Reynolds *et al.* 1982). Douglas-fir, lodgepole pine, Jeffrey pine, red fir, and western larch were used by goshawks in other Pacific coastal populations (Saunders 1982, Moore and Henny 1983, Hall 1984, Hargis *et al.* 1994, Daw 1996, McGrath 1997).

Goshawks often nest in one of the largest trees in the stand (Reynolds *et al.* 1982, Saunders 1982, Erickson 1987, Hargis *et al.* 1994, Ingraldi and MacVean 1995, Squires and Ruggiero 1996); height and diameter of nest trees are highly variable depending on forest type and geographic location. In Wyoming, goshawks chose nest trees that had larger diameter than trees at the nest site or in the nest stand (Squires and Ruggiero 1996). Likewise, in California, Saunders (1982) found that mean diameter of nest trees was 74.2 cm (29 in) (range 43.7 - 121.9 cm)(17.2 - 48 in), more than twice the mean diameter for trees in the immediate nest sites (33.2 cm)(13 in) or nest stands (27.1 cm)(10.7 in). In general, goshawks appear to choose nest trees based on size and structure more than the species of tree.

Goshawks usually construct their nests in the lower one-third of the nest tree, just below the forest canopy (Shuster 1980, Reynolds *et al.* 1982, Moore and Henny 1983, Speiser and Boskowski 1987). As a consequence of the consistent pattern of nest placement within trees, heights of goshawk nests are significantly correlated with nest-tree heights (Kennedy 1988, Speiser and Bosakowski 1989). Nest heights vary according to the species of nest tree and regional differences in tree heights. The average height of North American nests was 11.8 m (38.6 ft) (range = 6.1-25.7 m; 20 - 84 ft) (Apfelbaum and Seelbach 1983).

Typical territories often contain several alternate nests that are used by pairs over several years (Reynolds and Wight 1978, Speiser and Bosakowski 1987, Reynolds *et al.* 1994, Woodbridge and Detrich 1994, Reynolds and Joy 1998). During a 9 year period in northern California, the mean number of nests used by goshawk pairs was 2.6 (range = 1-5) and only 44% of nesting attempts were in nests used the previous year (Woodbridge and Detrich 1994). The spacing and distribution of alternate nests varied among territories; most nests were clumped in 2-3 adjacent stands whereas others were scattered up to 2.1 km (1.3 mi) apart. The mean spacing between alternate nests was 273 m (892 ft) (range = 30-2,066 m; 100 ft - 1.3 mi) (Woodbridge and Detrich 1994) in California, and on 59 territories in Arizona that contained alternate nests, the mean spacing was 489 m (1,604 ft) (range = 21- 3,410 m; 69 ft - 2.1 mi)(median = 285 m; 935 ft) (Reynolds and Joy 1998).

Nest Areas and Nest Stands

Dominant Forest Types

Forest types in western goshawk nest areas include pinyon/juniper, riparian cottonwood, ponderosa pine, Douglas-fir, pines, various species of spruce mixed with true fir, and aspen (White *et al.* 1965, Bartelt 1977, Reynolds *et al.* 1982, Saunders 1982, Hall 1984, Reynolds *et al.*

1990, Squires and Ruggiero 1996, Allison 1996, Desimone 1997).

Forest Structure

Goshawk nest habitat is often characterized as mature to old-growth forests composed primarily of relatively large trees with relatively high canopy closure (60-80%), near the bottom of moderate slopes, on north exposures and in areas with sparse ground cover (Reynolds *et al.* 1982, Moore and Henny 1983, Speiser and Bosakowski 1987, Hayward and Escano 1989, Ingraldi and MacVean 1995, Squires and Ruggiero 1996). The goshawk's inclination to nest in habitats relatively denser than surrounding forests may reduce predation and, when combined with north slopes may provide relatively cool environments (Reynolds *et al.* 1982). In Oregon, goshawks nest in dense, mature or old-growth conifers with a mean tree density of 482 trees/ha (range 273-750 trees/ha) (195 trees/ac; range 110 - 304 trees/ac) (Reynolds *et al.* 1982). Nest areas ranged from those with a few mature trees, but with dense understory trees, to those with closed mature canopies and sparse understory trees. Most nest areas were in older forests (n=74), but 5% (n=4) were in second growth forests, and 4% (n=3) were either in mature lodgepole pine or mixed stands of mature lodgepole and ponderosa pine; the lodgepole nest areas had relatively open, single-layered canopies (166 trees/ha; 67 trees/ac, 38% canopy closure). Goshawks in southcentral Wyoming nested in stands that were in even-aged, single storied, mature forests with high canopy closure and clear forest floors (Squires and Ruggiero 1996).

Forest stands containing nest areas are often relatively small. In northern California, goshawk territories contained 1-5 alternate nests in different nest stands (Woodbridge and Detrich 1994). The maximum distance recorded between nest stands was 1.8 km (1.1 mi), but approximately 85% of stands containing alternate nests were less than 0.7 km (0.4 mi) apart. In northern California, nest-stand clusters, defined nest-stand clusters as the aggregate area of all nest stands within a territory, ranged from 10.5 ha to 114 ha (26 - 282 ac) in size (Woodbridge and Detrich 1994). The occupancy rate of nest stands was positively correlated with stand size (Woodbridge and Detrich 1994). Smaller stands (<10 ha)(<25 ac) typically contained 1-2 nests that were occasionally occupied, whereas large stands (>20 ha)(>50 ac) were more consistently occupied. Woodbridge and Detrich also found that the annual occupancy of nest-stand clusters (clusters with at least 5 years of monitoring) was positively correlated with aggregate cluster size. Clusters less than 20 ha (50 ac) in size were occupied less than 50% of years, 75 to 80% of years for clusters approximately 40 ha (100 ac) and approximately 100% of years for clusters totaling greater than 61 ha (150 ac).

Although goshawk nest habitat has been widely studied, a number of potential biases in studies should be addressed. In some studies, nests were located during preparation of timber-sales which typically occur in older-aged forest stands. In others, observers only searched areas that met their preconceived notion of "suitable" goshawk nest habitat; typically, these areas only included mature and old-growth forests. Thus, knowledge of goshawk choice of nest sites may be biased toward older habitat types (Squires in prep). However, Daw *et al.* (in press) compared habitat characteristics in 0.4 ha areas around 27 nests found systematically and around 22 nests found opportunistically on three national forests in eastern Oregon and found that both density of

large trees and canopy closure were similar for nests found with either search method. However, these results do not preclude the fact that bias can be reduced by conducting nest searches in a systematic fashion across all habitats within landscapes.

Although goshawks appear to favor mature forests for nesting, there are exceptions. In California, goshawk nest habitat consisted of young and even-aged forests with sparsely distributed mature and old-growth trees (Farber *et al.* 1998). Goshawks also nest in tall willow communities along major drainages in the arctic tundra (Swem and Adams 1992) and in riparian cottonwood stands (White *et al.* 1965).

Canopy Closure and Tree Basal Area

Goshawk nests are usually in forests with high canopy closure. In northern California, canopy closure at nests ranged from 53 to 92% (Saunders 1982). In northern Arizona, the average canopy closure in nest areas was 76% goshawks (Crocker-Bedford and Chaney 1988).

In northern Idaho and western Montana, forest vegetation at nest sites in the mesic Columbia Highlands west of the Continental Divide were different from those in the drier Rocky Mountain zone to the east (Hayward and Escano 1989). High canopy closure at nest sites was the most uniform habitat characteristic in either geographic area. Tree basal area was the second most consistent habitat variable for the two populations, ranging from 29 to 54 m²/ha (126 to 235 ft²/ac); most (60%) nest stands were between 39 to 46 m²/ha (170 to 201 ft²/ac) (Hayward and Escano 1989).

Although goshawks apparently favor closed-canopy forests, birds will nest in more open forests. In Oregon, Reynolds *et al.* (1982) reported an average canopy closure of 59.8%, but nests were located in pure stands of mature lodgepole pine that were relatively open (166 trees/ha; 67 trees/ac 38% canopy coverage). In eastern California, canopy closure in nest stands was 31%, quite low compared to other goshawk studies (Hargis *et al.* 1994).

Forest Openings

Goshawks often nest close to forest openings such as meadows, forest clearings, logging trails, dirt roads and fallen trees (Gromme 1935, Reynolds *et al.* 1982, Hall 1984, Erickson 1987, Hayward and Escano 1989). In California, an average of one forest opening was present within 15 m (49.5 ft) of goshawk nests and averaged 113 m² (1,208 ft²) in size (Hall 1984). In South Dakota, canopy openings accounted for approximately 10% of the nest territory (Bartelt 1977); only two sites were not associated with an opening. Another South Dakota study found that all goshawk nests were near either old logging roads (78.6%) or forest openings (21.4%, Erickson 1987); the mean distance from the nest tree to either type of opening was 73.9 m (242 ft) (range 16.9 - 215 m; 55 - 703 ft). In California, goshawks nested an average of 85.3 m (279 ft) from medium-use roads (Saunders 1982).

The function of forest openings near nests is unclear. They may serve to increase access to the nest or to aid in locating nests. Erickson (1987) observed male goshawks on several occasions

returning high over the forest canopy with food, and then dropping into an opening or trail to deliver the prey to the female; he believed that openings and trails were used as access corridors to the nest. In Colorado, Shuster (1980) found that each of 20 goshawk nests were within 350 m (1,145 ft) of a 0.4 ha (1 ac) or larger opening. These were natural meadows that supported populations of ground squirrel prey.

Nest Area Forest Types as Reported

The following is a summary of the data for nest area forest types reported to the Service through the information request for the Status Review (Tables 3.2 - 3.7). There are biases and limitations associated with these data relative to how the data were collected and reported, which are discussed at length in the Status Review. Further, for analysis purposes, the list of specific tree species reported was reduced to a more refined list of forest types corresponding to Forest Inventory Assessment/Society of American Foresters forest cover type data as discussed in the Status Review. These data provide an example of forest types for known goshawk nests throughout the petitioned area. The Service views these data as a sample of forest types currently known to be used, and not a complete list of forest types used by goshawks.

Table 2. Forest Types reported from Assessment Area 1 for a total of 316 nest areas.

Forest Type	Number of Occurrences	Percent of Total
Douglas-fir	189	60
Lodgepole Pine	50	16
Ponderosa Pine	45	14
Hemlock-Sitka Spruce	14	4
Aspen-birch	6	2
Fir-spruce	6	2
Western Hardwoods	2	.6
Larch	1	.3

Table 3. Forest Types reported from Assessment Area 2 for a total of 328 nest areas.

Forest Type	Number of Occurrences	Percent of Total
Ponderosa Pine	161	49
Lodgepole Pine	82	25
Aspen-birch	52	16
Douglas-fir	16	5
Fir-spruce	17	5

Table 4. Forest Types reported from Assessment Area 3 for a total of 246 nest areas.

Forest Type	Number of Occurrences	Percent of Total
Ponderosa Pine	188	76
Douglas-fir	51	21
Aspen-birch	5	2
Western Hardwoods	1	.5
Pinyon-juniper	1	.5

Table 5. Forest Types reported from Assessment Area 4 for a total of 721 nest areas.

Forest Type	Number of Occurrences	Percent of Total
Aspen-birch	247	34
Douglas-fir	213	30
Lodgepole Pine	122	17
Ponderosa Pine	87	12
Fir-spruce	42	6
Western Hardwoods	7	1
Larch	2	.3
Pinyon-juniper	1	.1

Table 6. Forest Types reported from Assessment Area 5 for a total of 2,544 nest areas.

Forest Type	Number of Occurrences	Percent of Total
Douglas-fir	1,684	66
Ponderosa Pine	520	21
Fir-spruce	253	10
Western Hardwoods	57	2
Lodgepole Pine	24	1
Aspen-birch	6	.2

Table 7. Forest Types reported from Assessment Area 6 for 886 nest areas.

Forest Type	Number of Occurrences	Percent of Total
Douglas-fir	618	70
Ponderosa Pine	129	14
Lodgepole Pine	78	9
Fir-spruce	43	5
Larch	9	1
Hemlock-Sitka Spruce	4	.5
Aspen-birch	2	.2
Mixed conifer	2	.2
Pinyon-juniper	1	.1

Post-Fledging Area (PFA)

The PFA surrounds the nest area and includes the area used by the family group from fledging until young are no longer dependent on the adults for food (Kennedy 1989, Reynolds *et al.* 1992, Kennedy *et al.* 1994). Post-fledging areas may be important to fledglings by providing hiding cover and prey on which to develop hunting skills. During the post-fledging dependency period the activities of young are centered around their nests, but distances that fledglings move from the nest increased with time (Kennedy *et al.* 1994).

In New Mexico, PFAs averaged 170 ha (420 ac) in size and may correspond to the defended area (territory) of a goshawk pair (Kennedy *et al.* 1994). In New Mexico, the average distance fledglings moved from nests increased from 11.8 m (39 ft) in week 1 to 1955.6 m (1.2 mi) in week 8 (Kennedy *et al.* 1994). During the first 4 weeks following fledging, 88.1% of 193 locations were within 200 m (654 ft) of the nest and 99.5% were within 800 m (0.5 mi) of the nest. During the last 4 weeks of the fledgling-dependency period, only 34.3% of 108 locations were within 200 m (654 ft) of the nest and only 75.9% of locations occurred within 800 m (0.5 mi) of the nest.

Foraging Habitat

Goshawks have been observed hunting in habitats as diverse as open steppes and dense forests. Mature forested habitat, along with other habitat types and ages, are used for foraging.

In the southwestern United States, Reynolds *et al.* (1992) conducted in a literature review of the habitats of important goshawk prey and found that while some goshawk prey preferred forest openings, the majority were in mature and old forests. Beier and Drennan (1997) believed that

when goshawks selected foraging sites, prey abundance was not as important as was the accessibility of prey, which is influenced by forest structure (i.e., high canopy closure, high tree density) that make prey easier to locate and capture.

In Utah, a single radio-tagged male preferentially selected foraging in mature Douglas-fir/white fir stands compared to the availability of this habitat type (Fischer 1986). Hargis *et al.* (1994) found that radio telemetry locations (assumed to occur during foraging) were in forest stands with significantly higher basal area, more canopy cover, and more trees in large diameter classes than were randomly available. In the southern Cascades, goshawks selected mature and older stands with canopy closer of >40 percent; however, early-successional patches and openings also provided foraging opportunities, although goshawk use of these habitat types for foraging was not specifically investigated (Austin 1993).

In Colorado, Shuster (1980) observed goshawks hunting in openings and clearcuts. In Nevada, three males foraged in open sagebrush away from trees (based on 13 visual locations prior to transmitter loss), or along aspen groves to hunt Belding's ground squirrels in the surrounding sagebrush (Younk and Bechard 1992). These studies suggest that goshawks hunt in open and edge habitats but visual observations are subject to visibility bias.

Foraging habitat in forested environments can be partitioned into several layers from the forest floor to above the forest canopy. Reynolds and Meslow (1984) assigned bird and mammal prey species to four height zones (ground-shrub, shrub-canopy, canopy, aerial) on the basis of where each spends most of its time and found that approximately 40% of prey in goshawk diets were zone generalists and approximately 35% were most often in the ground/shrub layer. The remaining prey were evenly distributed between shrub-canopy and canopy layers. Large-bodied prey, which may be more important to breeding goshawks than smaller prey (Reynolds *et al.* 1992), were primarily associated with the lower forest strata or were zone generalists.

In Arizona, Boal and Mannan found that more prey was captured from the ground/shrub zone (62%) than all other zones combined. About 25% of prey were zone generalists, whereas prey from the shrub/canopy and canopy zones only accounted for 13.0% of prey. Highly aerial prey, such as swallows, were not observed in goshawk diets.

In the Coast Ranges of Oregon, where goshawks are rare, the forests contain high understory stem densities and dense undergrowth. Even though prey species in the Oregon Coast Ranges are varied and abundant, these forest conditions may make prey species difficult capture. DeStephano and McCloskey (1997) state that if a relationship between vegetation structure and the availability of prey does exist, then the forest conditions described above may limit prey availability to goshawks, potentially depressing or preventing reproductive activity.

Winter Habitat

Goshawk studies in North America that have investigated their migration and winter biology include Doerr and Enderson 1965, Alaska Dept. of Fish and Game 1993, Squires and Ruggiero

1995 and Beier 1997. Wintering goshawks use forests, woodlands, shrublands, and riparian-strip forests in search of prey (Squires and Ruggiero 1995, Beier 1997). In the Rocky Mountains of the United States, wintering goshawks use cottonwood riparian areas (Squires and Ruggiero 1995), aspen, spruce/fir, lodgepole pine, ponderosa pine and open habitats (Squires and Reynolds 1997). In northern Arizona, 13 adult goshawks used ponderosa pine and pinyon-juniper woodlands during two winters. In general, female goshawks (n=6) remained in the ponderosa pine vegetation type in the general vicinity of their nest stands throughout both winters. Most male goshawks moved 5-10 miles from the nest area and generally into the closest pinyon-juniper woodlands (Beier 1997).

Food Habits

Like other raptors, the food habits of goshawks have been determined by : 1) examination of stomach contents, 2) removing food from crops of nestlings, 3) direct observation of nests, 4) prey remains, and 5) regurgitated pellets (Sherrod 1978). Analysis of pellet/food remains and direct observation of nesting birds are the primary techniques used to determine goshawk food habits. Younk and Bechard (1994) found that goshawks only plucked birds at plucking perches, whereas ground squirrels were taken directly to the nest. Thus, in some areas, quantifying prey remains at plucking perches may be biased toward avian and large-bodied prey. However, Kennedy (1991) compared three techniques (remains analysis, pellet analysis, and direct observation) for studying the food habits of Cooper's hawks and goshawks and found that all yielded similar rankings of prey taxa. She concluded that periodic samples of prey remains at nests adequately characterized diet composition of nesting goshawks. Collopy (1983) found similar results for golden eagles.

Very little is known about the winter diets of North American goshawk populations. Beier (1997) made 27 observations of birds with freshly-killed prey during the winter and suggested that individual goshawks specialized in taking cottontails or Abert's squirrels, but not both. Wintertime prey base was dissimilar to summertime prey (e.g., golden-mantled ground squirrels, chipmunks and other hibernators) suggesting predation efficiency was based on prey availability and opportunism.

Prey Taxa and Abundance in Diets

North American goshawks prey on a variety of birds and mammals (Schnell 1958, Meng 1959, Reynolds and Meslow 1984, Boal and Mannan 1994, Bull and Hohmann 1994, Reynolds *et al.* 1994, Younk and Bechard 1994). In summarizing the diets of various North American goshawk populations, Sherrod (1978) found mammals numerically comprised 21 to 59% of diet whereas avian prey represented 18 to 69%. In Arizona, mammals accounted for 94% and birds 6% of prey biomass delivered to goshawk nests (Boal and Mannan 1994). In five North American studies, the average composition was 33.8% mammalian and 64.4% avian prey (Jones 1979). Herptiles and invertebrates were occasionally taken. Table 8 shows the proportion of mammalian and avian prey in the diets of northern goshawks during the nesting season as reported by various researchers.

Like most predators, goshawks are opportunists. Diets vary among populations as prey availability changes regionally and seasonally. Over 30 species of mammalian and 53 species of avian prey have been identified in diets from goshawk populations in North America. However, a few prey taxa are particularly important to most goshawk populations: chipmunks (*Eutamias* sp), cottontail (*Sylvilagus* sp), snowshoe hare (*Lepus arcticus*), Douglas squirrel (*Tamiasciurus douglasi*), red squirrel (*Tamiasciurus hudsonicus*), golden-mantled ground squirrel (*Citellus lateralis*), gray squirrel (*Sciurus* sp), northern flying squirrel (*Glaucomys sabrinus*), American robin (*Turdus migratorius*), blue jay (*Cyanocitta cristata*), Steller's jay (*Cyanocitta stelleri*), ruffed (*Bonasa umbellus*) and blue grouse (*Dendragapus obscurus*), common crow (*Corvus* sp), domestic pigeons (*Columba livia*), and northern flicker (*Colaptes auratus*).

Sciurids including chipmunks and tree and ground squirrels represent an important group of prey. Squirrels occur in most goshawk diets due to their high abundance and broad distribution. In California, Woodbridge *et al.* (1988) found that sciurids were present in 55.0% of diets and contributed 59.1% to the food biomass, whereas total mammals (9 spp.) provided 81.5% of prey biomass. Important sciurids in terms of biomass included golden-mantled ground squirrels (15.6%), Douglas squirrels (14.7%), and western gray squirrels (9.3%, Woodbridge *et al.* 1988).

Rabbits and hares are large-bodied prey that are used extensively by goshawks (Reynolds and Meslow 1984, Kennedy 1991). Cottontail rabbits are abundant in most habitats and are distributed throughout the goshawk's range. Boal and Mannan (1994) found that cottontails contributed the greatest proportion of prey biomass (26%) taken by goshawks, and together with golden-mantled ground squirrels accounted for 41% of all identified prey. Snowshoe hares are also important prey, particularly in northern and boreal forests (Mendall 1944, McGowan 1975a, Doyle and Smith 1994).

Gallinaceous birds (primarily grouse) are important prey for North American goshawks (Mendall 1944, McGowan 1975, Gullion 1981a, b, Gullion and Alm 1983, Apfelbaum and Haney 1984). Robins are moderate-sized thrushes that are widely distributed throughout the geographic range of nesting goshawks and are present in most goshawk diets. Robins constituted 6.6% of the diet of goshawks in eastern Oregon (Reynolds and Meslow 1984). Steller's jays and other corvids (crows and jays) are common residents of conifer and mixed-species forests. Steller's jays, along with northern flickers, were the most common avian prey species (16%) of goshawks nesting in Arizona (Boal and Mannan 1994). In California, Steller's jays were present in 12% of remains (Bloom *et al.* 1986) whereas in New Mexico, they comprised 17% of total birds in goshawk diets (Kennedy 1989). On the Shasta-Trinity and Klamath National Forests in California, Steller's jays comprised 16.6% of numbers of prey and 6.3% of biomass (Woodbridge *et al.* 1988).

Table 8. Proportion of mammalian and avian prey in diets of northern goshawk during the breeding season (from Squires and Reynolds 1997).

Location	Percentage of Mammalian Prey (biomass)	Percentage of Avian Prey (biomass)	Study
United States			
Alaska	78 (90)	21 (10)	Zachel 1985 ¹
Arizona	76 (94)	24(6)	Boal and Mannan 1994 ³
Arizona	62	38	Reynolds <i>et al.</i> 1994 ^{1,2}
California	32	68	Bloom <i>et al.</i> 1986 ²
Nevada	67	32	Young and Bechard 1994 ³
New Mexico	49	51	Kennedy 1991 ¹
New York	39	61	Grzybowski and Eaton 1976 ²
Oregon	42	59	Bull and Hohmann 1994
Oregon	45	55	Reynolds and Meslow 1984 ^{1,2}
Utah	82	18	Lee 1981 ^{1,2}
Canada			
Yukon	---(86)	---(13)	Doyle and Smith 1994 ²
Sweden	21.3 (15.2)	78.6 (84.8)	Widen 1982 ²

¹ Pellet analysis

² Prey remains

³ Direct observation

Woodpeckers, including Williamson's sapsucker (Reynolds *et al.* 1994, Schnell 1958), northern flicker (Eng and Gullion 1962, Erickson 1987), pileated woodpecker (Allen 1978, Eng and Gullion 1962, Reynolds and Meslow 1984), black-backed woodpecker (Erickson 1987), three-toed woodpecker (Erickson 1987, Gullion 1981b) and hairy woodpecker (Fleming 1987), collectively are important goshawk prey. In California, woodpeckers comprised 3.1% of total prey biomass (Woodbridge *et al.* 1988). Northern flickers are particularly important in many goshawk diets (Grzybowski and Eaton 1976, Reynolds and Meslow 1984, Bloom *et al.* 1986, Boal and Mannan 1994). Flickers are large birds that often forage on the ground, have conspicuous markings and behavioral displays, and are widely distributed (Reynolds *et al.* 1992). In New Mexico, northern flickers comprised 26.4% of total birds present in the diet of nesting goshawks (Kennedy 1989).

Foraging Behavior

Goshawks, like other accipiters, have evolved morphological and behavioral adaptations for hunting in forests. Relative to open country hawks and falcons, goshawks have short wings and long tails for maneuvering in and below a forest canopy. Goshawks have robust feet and bill that are adapted for capturing and eating a wide variety of comparatively large prey (Wattel 1973).

As in most raptors, male goshawks provide the female with food during incubation and nesting, while the female primarily guards the nest (Reynolds 1972, Newton 1974, Allen 1978). For example, Schnell (1958) observed that of 88 prey items brought to the nest, 73 (85%) were brought by the male and 13 (15%) by the female. Of the total 5,866 g (13 lbs) of prey brought to the nest, the male secured 4,838 g (10.71lbs) (82.5%) and the female 1,028 g (2.38bs) (17.5%).

Goshawks are short duration-sit-and-wait predators; this hunting style is suited to foraging in forests where visibility is limited (Reynolds *et al.* 1992). Hunting goshawks typically make short flights to perches from which they briefly search an area for prey before flying a short distance to the next perch. Thus, foraging goshawks move rapidly through the forest, perch to perch, punctuated with brief periods of prey searching. Goshawks occasionally hunt by flying rapidly along forest edges, across openings, and through dense vegetation in an effort to surprise prey. However, only 3% of goshawk attacks on prey were from hawks already in flight (Kenward 1982). Hunting goshawks readily use trees, shrubs, and topographic features as cover for approaching prey (Backstrom 1991). Goshawks may at times stalk prey (Bergstrom 1985), and may capture quarry through dogged persistence rather than using surprise attacks (Westcott 1964, Brace 1983).

Foraging success and prey delivery rates vary according to prey type, hunting experience, and habitat characteristics. In Arizona, Boal and Mannan (1994) observed 385 prey deliveries to nests at the rate of 0.25 items/hr. During 19 days of observation, Schnell (1958) observed a male goshawk deliver 75 food items at the rate of 3.9 items per day. The male delivered food to the nest during all daylight hours, but more prey was delivered in the early morning (6:00-7:00 am) and in the afternoon and evening (4:00 - 8:00 pm). Kenward (1982) found that only 6% of the attacks during the winter were successful, and that wintering hawks hunted an average of 262 minutes per kill.

Caching surplus food has been recorded in small falcons to large eagles (Newton 1979). Food caching occurs most frequently during the breeding season, but some raptors cache throughout the year. This behavior saves food for future use during periods of low food availability. Goshawks cache food when nestlings are small and unable to consume entire prey (Schnell 1958). In Schnell's study, the female ceased caching prey when nestlings were approximately one month old.

Although not well documented, the distances that males hunt from their nests probably vary by habitat type, nesting phenology, prey density, and the number of observations the study documented. Kennedy (1988) found (preliminary data) that radio-tracked goshawks did not hunt

immediately adjacent to the nest, but foraged mostly between 0.8 km to 8 km (0.5 to 5 mi) of the nest. Of 11 prey items the female brought to the nest, five were caught in the nest vicinity and six were captured outside a 91 to 122 m (300 - 400 ft) radius from the nest (Schnell 1958). The female's capture of prey appeared to be fortuitous and was dependent on prey abundance in the nest area.

Population Ecology

Changes in the number of animals in a population over time are a function of four demographic parameters: reproduction, survival, immigration, and emigration. Population ecology is concerned with determining how factors such as population density, distribution, age structure, resource availability, habitat distribution, competition, and climate influence these population parameters. Thus, population ecology studies provide information critical for formulating management plans for a species (Leslie in prep).

Chronology

Annual Cycle

Activities and behaviors associated with breeding typically occur between late March and mid to late August (Leslie in prep). Males do most of the foraging while females incubate, brood and feed the young, and defend the nest. Females may occasionally forage during the nestling period, with this tendency becoming more pronounced during years of low prey availability (Newton 1986, Ward and Kennedy 1996).

Pre-Laying Period

Goshawks have been observed near their nesting areas as early as late February (Lee 1981), but are typically observed for the first time in early to late March (Zirrer 1947, Reynolds and Wight 1978, Widen 1984, Beier 1997). However, in some areas goshawks may occupy their nesting areas throughout the winter (Leslie in prep).

Females apparently do most of the nest building, with males contributing only occasionally (Zirrer 1947, Lee 1981). Females may aggressively defend the nesting area during this period (Zirrer 1947). As in many raptors, the female becomes sedentary as egg laying approaches, presumably to acquire the energy reserves necessary for egg formation (Reynolds 1972, Newton 1979, Lee 1981). The male delivers prey directly to the female during this time.

Incubation Period

Timing of clutch completion varies considerably among pairs, geographic areas, and years - the dates ranging from 10 April to 2 June (Reynolds and Wight 1978, Henny *et al.* 1985, Reynolds *et al.* 1994). On average, clutches are completed between late April and early May.

The incubation period has been estimated at 30 to 32 days by Reynolds and Wight (1982), 36 to 38 days by Brown and Amadon (1968) and Snyder and Wiley (1976), and an average of 43.7 days by Lee (1981). Differences among estimates may be due to individual, geographic, or annual

variation in the length of incubation, or may be attributed to measurement error. Eggs are laid at 2-3 day intervals (Holstein 1942). The female is generally reluctant to leave the nest during this period.

Nestling Period

Hatching generally occurs between late May and early June (McGowan 1975, Reynolds and Wight 1978, Lee 1981, Reynolds *et al.* 1993) although variation in hatch date is considerable. The nestling period varies from 37 to 45 days (Dixon and Dixon 1938, Brown and Amadon 1968, McGowan 1975, Reynolds and Wight 1978, Newton 1979, Kenward *et al.* 1993, Boal 1994). Young generally fledge between early and late July (Reynolds and Wight 1978, Reynolds *et al.* 1994).

Females brood for up to 3 hours at a time, and may spend up to an hour perched near the nest (Siewart 1933, in Schnell 1958). Females do most of the brooding, but males may brood for up to 2 hours after a prey delivery while the female feeds (Siewart 1933, in Schnell 1958). Apparently, only the female directly feeds the young (Lee 1981) prior to fledging. Females may occasionally forage in and around the nest stand during the nestling period, but males probably provide a minimum of 85% of the prey items delivered to the nest (Siewart 1933, in Schnell 1958, Boal and Mannan 1994). For the first few days post-hatching, the female broods the young and only rarely attacks intruders entering the nest stand. Adult females can be aggressive toward human intruders later in the nestling period (Boal and Mannan 1994). In addition, response rates to broadcasts of conspecific calls are high during this period, facilitating detection of nests (Kennedy and Stahlecker 1993, Joy *et al.* 1994).

Post-Fledging Period

This period begins when the young leave the nest and continues until they are no longer dependent on the adults for food. The fledgling-dependency period is an important period of transition during which the young learn to hunt and fend for themselves. Feather growth is not yet complete (Bond 1942) and young, at least initially, are incapable of sustained flight. As a result, fledglings may have special habitat requirements during this period (Bartelt 1977, Kennedy 1989, Kennedy *et al.* 1994, Reynolds *et al.* 1994).

The post-fledging period has been estimated at a minimum of 6 weeks in North American (Zirrer 1947, Reynolds and Wight 1978). For the first 3 weeks after fledging, juveniles tend to remain within 300 meters of the nest, after which they gradually venture farther away (Kennedy *et al.* 1994). Dispersal is abrupt, with males dispersing approximately 7 days earlier than females (Kenward *et al.* 1993).

Movements

Movements of birds beyond home range boundaries have been classified in several ways. Typically, 3 types of movement are distinguished: migration, natal dispersal, and breeding dispersal. Natal dispersal is defined as movements between a bird's place of birth and the area where it subsequently breeds (Greenwood 1980). Breeding dispersal is defined as movements

between years among breeding sites (Greenwood 1980). Dispersal (both breeding and natal) is an important component of population dynamics. The impact of dispersal on avian population dynamics has only recently been fully appreciated, and is the least studied component of avian population dynamics (Lebreton and Clobert 1991, Newton 1991).

Natal Dispersal

Successful dispersal is essential to the genetic and demographic viability of populations. Habitats used during dispersal, dispersal direction, and dispersal distances have been little studied in the goshawk. The information available comes from recapture of marked birds, band returns, radio-telemetry and satellite telemetry (Beier 1997, Leslie in prep).

Two records of band returns are available from the southwestern United States. In both cases, recoveries occurred in the year of banding at distances of 160 and 176 km (100 and 109 mi) (P. Kennedy, unpublished data, Reynolds *et al.* 1994). Distances from natal nest sites of 16 juveniles radio-tagged in New Mexico ranged from 5.5 to 176 km (3.4 - 109 mi) (P. Kennedy, unpublished data).

Six instances of natal dispersal were reported on the Kaibab Plateau; three males first nested from 10.3 km (5.4 mi) to 23.0 km (14.3 mi) from their natal site, and three females first nested from 15.0 km (9.3 mi) to 32.0 km (19.9 mi) from their natal site (Reynolds and Joy 1998). These distances are most likely biased low by constraints imposed by the size of the study area; some natal dispersal off the study area may have occurred but was not detected.

In the southern Cascades of California, Detrich and Woodbridge (1994) documented two females banded as nestlings who were recaptured as adults 16.1 and 24.2 km from their natal sites.

Breeding Dispersal

Movements between years by adult goshawks from one breeding-site to another include movement between alternate nests within a territory, and movements of individuals from one territory to another. While movements of the first type are not important demographically, they confound detection and interpretation of the latter. The two types of movement can be distinguished only by the study of marked individuals. Breeding dispersal could result from death of a mate, or may represent an attempt to acquire a better territory or mate. In northern Arizona, three birds that moved from one territory to another between years all produced more young the year following the move (Reynolds *et al.* 1994).

In about 320 opportunities (years in which hawks were recaptured/resighted on territories subsequent to 1st year of banding), seven instances of breeding dispersal (2 males, 5 females) were recorded in Northern Arizona (Reynolds and Joy 1998). Mean male breeding dispersal distance was 2.8 km (1.7 mi) and 5.2 km (3.2 mi) for females. These distances were equivalent to moving to an adjacent territory for males and about two territories for females (Reynolds and Joy 1998). Detrich and Woodbridge (1994) reported higher rates of breeding dispersal in northern California. Four of 22 females (18.2%) and 3 of 13 males (23.1%) were found breeding in more

than 1 territory over 9 years. Dispersal distances averaged 9.8 km (6 mi) for females and 6.5 km (4 mi) for males. As with natal dispersal distances based on recaptures, maximum breeding dispersal distances are constrained by study area size and thus may not be representative of the true distribution of dispersal distances.

Territory and Mate Fidelity

Fidelity to mates is difficult to assess in goshawks because the fate of previous mates is often unknown. Thus, mate fidelity can be confounded with mate replacement due to mortality. For example, Detrich and Woodbridge (1994) reported that breeding adults in northern California retained the same mate on average 72% of the time. However, the 28% of cases in which adults were subsequently found to be paired with new mates could have been due to death of the previous mate. Detrich (pers. comm.) noted that in a few cases, new pairing was not due to death, citing a recent example of a female who returned to a previous mate after a two year absence during which she bred with another male at least one year. Reynolds *et al.* (1994) reported a replacement rate of 23% between 1991 and 1992 in northern Arizona (7 replacements in 30 opportunities to detect it where opportunity = a bird of the same sex captured or recaptured on the same territory). However, in only one case out of 70 recaptures from 1992 to 1994 could divorce be established (i.e. previous mate known to be alive, Reynolds *et al.*, unpublished data). However, Detrich and Woodbridge (1994) reported that in 3 territories observed for 5 years, 2 males and 2 females bred in three different combinations. Patterns of mate fidelity may be dissimilar in the 2 populations (Leslie in prep).

Territory fidelity is confounded in a manner similar to that of mate fidelity. In New Mexico, 5 of 7 adults banded on their nesting areas in 1990 were re-sighted in the same nesting area in 1992 (P. Kennedy, unpublished data). In northern Arizona, 6 of 10 territories where both sexes were captured in two consecutive years remained on the same territory with the same mate. Of the four remaining territories, two had both members replaced and two had one member of the pair replaced (Reynolds *et al.* 1994). None of the replaced individuals have been subsequently resighted. In 6 years of capture-recapture study of marked goshawks during 478 territory-years in northern Arizona, Reynolds and Joy (1998), found that males annually remained faithful to their territories 91.3% of the time and females 77.8% of the time. Conversely, adult males and females in northern California occupied the same territory in consecutive years 76.5 and 71.4% of the time. Males were significantly more likely than females to remain on the same territory in consecutive years (Detrich and Woodbridge 1994).

Spatial Structure

Spatial structure refers to the pattern in which birds distribute themselves over the landscape in relation to food, nest sites, habitat, other resources, and each other. Spatial patterns are scale dependent.

Dispersion

A consistent characteristic of goshawk populations is the regular spacing of breeding pairs (McGowan 1975, Schuster 1976, Reynolds and Wight 1978, Kennedy 1988, Reynolds *et al.*

1994, Reynolds and Joy 1998). Widen (1985) and Buhler and Oggier (1987) quantified the dispersion of goshawk territories using nearest-neighbor distances in Sweden and eleven study areas in Switzerland, respectively. The mean nearest neighbor distance among 103 territory centers on a 700 mi² study area in northern Arizona was 3.9 km (2.5 mi) (disallowing duplicate measurements) (Reynolds and Joy 1998). In all cases, the distribution of territories was significantly regular. Mean nearest neighbor distances in North America range from 3.0 to 5.6 km (1.8 - 3.5 mi). While nests as close as 0.8 km (0.5 mi) have been reported (Schuster 1976), such close spacing rarely lasts more than 1 to 2 years (Reynolds and Wight 1978).

A regular distribution of nesting pairs could result from the distribution of suitable habitat and/or territorial behavior. The size of goshawk home ranges makes defense of the entire area unlikely. Thus, mutual avoidance in some form seems likely (Leslie in prep). Newton (1979) has argued that spacing behavior is the mechanism by which raptor populations adjust density to resource abundance.

The mechanism by which goshawks distribute themselves over the landscape is important for management in that density dependence may be a factor regulating goshawk populations (Maguire 1992). Spacing behavior may limit the number of pairs an area can support below that dictated by availability of food or nest sites (Fretwell and Lucas 1972, Bernstein *et al.* 1991, Smith *et al.* 1991). If spacing behavior limits the number of breeding pairs in a landscape, provision of additional nest habitat would have no effect on breeding rates (Leslie in prep).

At larger spatial scales encompassing several mountain ranges or forest patches, the distribution of nesting areas becomes clumped. Consideration of the size and distribution of these habitat patches - and the degree to which exchange of individuals between habitat patches is possible - are important considerations in developing conservation strategies (Leslie in prep).

Density

Two primary methods have been used to estimate goshawk densities: (1) estimates based on a census of breeding pairs, and (2) estimation of density from the distribution of nearest neighbor distances. Density calculated from a census can be either crude density (birds per unit area), or ecological density (birds per unit of suitable habitat). Because searches for goshawk nests are often conducted only in "suitable" habitat, many studies actually report ecological density. Each technique relies on a number of assumptions, the most fundamental of which is that counts are complete and accurate. This assumption is problematic in that non-breeding birds often go undetected. In some cases, the number of traditional nest areas is used in density calculations, while in others only active nests are included. In most cases, only breeding birds in regularly occupied territories have been accounted for in density estimates. In addition, density estimates are sensitive to the size of the area searched due to edge effects, particularly for species such as goshawks that occur at relatively low densities. However it is measured, goshawks occur at low densities relative to many avian species (Leslie in prep).

Density estimates from North American populations range from less than 1 up to 11 pairs per 100

km² (Table 9). Reynolds and Joy (1998) estimated the total number of nesting pairs of goshawks on the Kaibab Plateau, northern Arizona, by dividing their study area (173,168 km²) by an exclusive “area” (circular area with radius equal to half the mean nearest-neighbor distance among territory centers) of 1,182 ha (2,920 ac) per pair of goshawks. The estimated total of 146 pairs makes the 107 goshawk territories already identified by them in 1996 equal to about 73% of the estimated population, and resulted in an overall density of 11.9 pairs per 100 km² (Reynolds and Joy 1998). Conversely, the low of 0.3 pairs per 100 km² from Alaska in 1972 (McGowan 1975) may be indicative of a general breeding failure in the year of the estimate, with non-breeding pairs going undetected, or insufficient survey effort. However, density estimates from Alaska for all 4 years are lower than other estimates from North America and exhibit considerable annual variation.

Table 9. Nesting density of northern goshawks in North America (Squires and Reynolds 1997).

Location	Year	Density, pairs/100km ²	Forest Type	Study
Alaska	1971-1974	0.3-2.4 ¹	Aspen/spruce/birch	McGowan 1975
Arizona	1991-97	11.9 ²	Ponderosa pine/mixed conifer	Reynolds 1998
California	1984-1992	10.7	Sierran montane, upper montane	Woodbridge and Detrich 1994
Colorado	1974	5.8	Lodgepole pine/aspen	Shuster 1976
New Mexico	1984-1988	6.4	Ponderosa pine	Kennedy 1989
Oregon	1992-1993	6-7	Mixed conifer	DeStefano <i>et al.</i> 1994
Oregon	1974	3.6	Ponderosa pine	Reynolds and Wight 1978
Pennsylvania	1988-1991	1.17 ³	Northern hardwood/Appalachian oak	Kimmel and Yahner 1991
Yukon Territory	1990	5	Spruce/aspen	Doyle and Smith 1994

¹ Variation across years.

² Estimated density based on nearly complete counts over approximately 73% of a 1,732 km² (669 mi²) study area.

³ Variation across study years.

Methodological problems frustrate attempts to assess patterns in density. However, Buhler and Oggier (1987) reported densities from 11 study areas in Switzerland and found them to be significantly correlated with elevation and the proportion of forest in the study area. They concluded that elevation itself was probably correlated with prey abundance.

Demographics

Age Structure

Goshawks can be placed into 3 classes during the breeding season based on plumage characteristics (Bond and Stabler 1941, Mueller and Berger 1968, Henny *et al.* 1985, Reynolds *et al.* 1994). Recaptures of known age birds supports the hypothesis that these plumage classes correspond to age-classes (Reynolds, unpublished data). The term Subadult refers to birds between 1 and 2 years of age with primarily juvenile plumage. Young adult refers to birds between 2 and 3 years of age with primarily adult plumage but retaining some juvenile feathers either on the chest, back or scapular region. The term Adult refers to birds greater than 3 years of age with full adult plumage.

Subadult female goshawks have been observed breeding, but no observations of subadult males breeding have been reported. Frequency with which subadult females breed varies geographically and temporally. In Oregon, Reynolds and Wight (1978) reported 70 observations of breeding females, none of which were subadults, while Henny *et al.* (1985) reported 2 of 46 (4.3%) breeding females in this age-class. In Nevada, 5 of 14 (36%) breeding females were subadult in 1991, no subadults were observed to breed in 1992, and 1 of 25 (4%) breeding females were subadult in 1993 (Younk 1994). In contrast, no subadults have been observed to breed in 87 and 114 observations of breeding males and females, respectively, in 1991-1994 in a northern Arizona population (Leslie and Reynolds, unpublished data). In addition, only 1 case of a breeding subadult has been observed in banding studies in northern California or New Mexico, both of which have been ongoing for over 11 years (P. Kennedy and B. Woodbridge, unpublished data).

The frequency with which young adults breed is also geographically and temporally variable. Fall and winter trapping in interior Alaska resulted in estimates of 69, 50, 40, and 10% of birds trapped during 1971-74, respectively, being in the young adult age-class (McGowan 1975). In Arizona, 6.8% of breeding males and 12.2% of breeding females trapped during 1991 and 1992 were young adults (Reynolds *et al.* 1994), while in Nevada, 11 of 22 (50%) breeding females observed in 1992 and 1 of 25 females (4%) in 1993 were young adults (Younk 1994).

Reproduction

Because fecundity of goshawks is difficult to measure, various indices of reproductive success are utilized depending on the type of study and intensity of data collection. Resolution of a particular measure of reproductive success is proportional to the intensity of data collection, and ranges from the mean number of young fledged per successful nest (least resolution) through fecundity (most resolution)(Leslie in prep).

The use of multiple measures of reproductive success has led to the adoption of various terminologies. An occupied territory is defined as a territory exhibiting evidence of fidelity or regular use by a goshawk, and thus represents a potentially breeding bird. Occupancy rate has been generally defined as the proportion of known territories that are occupied (Leslie in prep).

An active territory or nest is defined as a territory or nest in which eggs are laid. A successful territory or nest is one in which at least one young is fledged. Nest success is the proportion of active nests that fledge at least one young. This term is occasionally used to refer to the proportion of occupied territories that fledge at least one young. Productivity is defined as the mean number of young fledged per successful nest, but has also been used to represent the mean number of young produced per nest attempt (i.e. per active nest)(Leslie in prep).

Bias in estimates of reproductive parameters arise primarily due to the difficulty associated with locating goshawks. Reproductive success is generally overestimated due to the greater probability of detecting breeding versus non-breeding pairs and successful versus unsuccessful nests. Territorial, non-breeding pairs commonly go undetected, as do pairs in which the nest attempt fails early in the nesting cycle. Difficulty of access to high-elevation sites early in the breeding season may preclude identification of early season nest failures (Detrich and Woodbridge 1994). Because goshawks may use alternate nests up to 1.3 km apart, active nests often go undetected due to insufficient effort in determining occupancy. Thus, the number of active nests under observation during a study decreases in the absence of rigorous searches for alternate nests (Crocker-Bedford and Chaney 1988).

Proportion of pairs breeding

Little information exists concerning the proportion of pairs that attempt to breed annually. In a six year study, including 478 territory-years, of goshawks in northern Arizona, Reynolds and Joy (1998) found that the proportion of pairs annually laying eggs declined from highs in 1991-93 (77- 87%) to lows in 1994-96 (22-49%). Reynolds and Joy (1998) believe that annual variations in proportions of pairs laying eggs is related to annual fluctuation in prey populations; in poor prey years more females are probably unable to secure sufficient food to form a clutch of eggs.

Clutch size

Mean clutch size in interior Alaska was 3.2, with estimates from individual years ranging from 3.0 to 3.8 (1971 - 1973)(McGowan 1975). Estimates from Utah and Oregon were 3.75 and 3.2, respectively (Reynolds and Wight 1978, Lee 1981).

The only estimates of hatching success are from 5 clutches in Oregon where 81.2 percent of eggs laid hatched (Reynolds and Wight 1978). Only one instance of re-nesting after failure of the initial clutch has been reported (Henny *et al.* 1985).

Nest Success

All published values of nest success are based on the naive estimator of the ratio of successful to total number of active nests rather than the unbiased estimator proposed by Mayfield (1961, 1975). The bias of the naive estimator has been demonstrated repeatedly and stems from the greater probability of detecting successful nests relative to failed nests (Miller and Johnson 1978, Johnson 1979, Hensler and Nichols 1981, Steenhof and Kochert 1982). This is particularly relevant for goshawks due to the difficulty associated with locating their nests. Thus, timing and duration of surveys and variation in effort all effect the magnitude of bias in the naive estimator.

Table 10 shows some of the published number of young per successful clutch for northern goshawk populations in North America as reported in Squires and Reynolds (1997). Estimates of nest success range as low as 44 percent and as high as 94 percent.

Table 10. Reproductive performance of northern goshawk populations in North America. Data shown as mean \pm SD (n). Asterisk indicated SE, instead of SD. Taken from Squires and Reynolds 1997.

Location	Year	Fledglings per Active Nest ¹	Fledglings per successful nest ²	Nest Success ⁴ (%)	Study
Alaska	1971-1973	2.0 (33)	2.7 (33)		McGowan 1975
Arizona	1991	2.0 \pm 0.77 (36)	2.2 \pm 0.61 (34)	94 ³	Reynolds <i>et al.</i> 1994
Arizona	1992	1.8 \pm 1.05 (59)	2.2 \pm 0.72 (49)	83 ³	Reynolds <i>et al.</i> 1994
Arizona	1990-1992	1.9 \pm 1.0 (6-8)	2.2 \pm 0.7		Boal and Mannan 1994
California	1981-1983	1.7 (127)		91	Bloom <i>et al.</i> 1986
California	1987-1990	1.39 (23) ³	1.78 (18) ³	82.5 (30) ³	Austin 1993
New Mexico	1984-1988	0.94 (16)	2.14 (16)	44	Kennedy 1989
New York/ New Jersey	1977-1990	1.4 (36)		80	Speiser 1992
Oregon	1992	1.2 (12)	1.4 (10)	83	Bull and Hohmann 1994
Oregon	1969-1974	1.7 (48)		90.4	Reynolds and Wight 1978
Yukon	1989		2.0 \pm 0.35* (3)		Doyle and Smith 1994
Yukon	1990		3.9 \pm 0.37* (8)		Doyle and Smith 1994
Yukon	1991		2.3 \pm 0.25* (7)		Doyle and Smith 1994
Yukon	1992		0 (1)		Doyle and Smith 1994

¹ Nests in which eggs were laid

² Nests in which young fledged

³ Calculated from presented data

⁴ Nest success calculated based on naive estimator of ratio of successful to total number active nests. Note potential bias because of greater probability of detecting successful nests relative to failed nests.

Causes of nest failure include human disturbance (e.g. shooting of adults, tree harvest activities) (Hoglund 1964, Oakleaf 1975, Hennessy 1978, Buhler *et al.* 1987), great horned owl and goshawk predation (Hennessy 1978, Ward and Kennedy 1996), disease (McGowan 1975, Ward and Kennedy 1996), mammalian predation (McGowan 1975, Hennessy 1978, Doyle and Smith 1994), and inclement weather (Hennessy 1978). Food limitation can result in higher predation rates on nestlings because females must allocate more time to foraging and less time to defense of young (Ward and Kennedy 1996).

Productivity

Productivity in North America ranges from 1.4 to 3.9 young per successful nest (Table 11). The highest estimates of productivity in North America are from Yukon, Canada and interior Alaska (McGowan 1975, Doyle and Smith 1994) which may indicate that birds from higher latitudes are capable of laying larger clutches and raising larger broods in years of high prey availability. An analysis of components of variance in productivity (i.e. separation of sampling variance from parameter variance across years) using the formula in Burnham *et al.* (1987) has been conducted for a population in northern Arizona (Leslie, unpublished data). Parameter variance over a 3 year period was significantly different from 0, indicating that productivity is also an important source of variation in goshawk reproductive success.

Nestling mortality rates have been estimated in two studies in North America. Kennedy (1988, 1993) reported nestling mortality rates in New Mexico of 25 and 15.6 percent for 1989 and 1993, respectively. Reynolds and Wight (1978) reported an average nestling mortality rate of 28 percent for birds in Oregon, and Høglund (1964) reported 20 percent mortality from egg laying to fledging. He attributed most mortality to egg loss rather than nestling mortality.

A sex ratio at fledging of 1:1 has been reported by Kenward (1993b) for the European subspecies and by Reynolds *et al.* (1994) for northern Arizona. However, Kenward (1993b) reported that in years of marked brood reduction, the sex ratio was biased toward females.

Table 11. Mean young per active, occupied and per successful nest (\pm SD) for various goshawk populations in North America and Europe (From Leslie in prep).

Years	Mean Young per Occupied Nest	Mean Young per Active Nest	No. Active Nests	Mean Young per Successful Nest	No. Successful Nests	Location	Source
North American Subspecies							
1972-76				1.77 \pm 0.44	13	South Dakota	Bartell 1974
1981-83		1.71	127			California	Bloom <i>et al.</i> , 1986
1992		1.20	12	1.40	10	Oregon	Bull and Hohmann 1994
1989	1.3 \pm 0.88			2.0 \pm 0.35		Yukon, Canada	Doyle and Smith 1994
1990	2.8 \pm 0.57			3.9 \pm 0.37		Yukon, Canada	Doyle and Smith 1994
1991	1.3 \pm 0.47			2.3 \pm 0.25		Yukon, Canada	Doyle and Smith 1994
1992	0.0			0.0		Yukon, Canada	Doyle and Smith 1994
1979-85		3.00				Utah	Fischer <i>et al.</i> , in Reynolds 1989
1992	1.83			2.36	14	New Mexico	Kennedy pers. comm., 1993
1984-86 & 1988		0.94	16	2.14	?	New Mexico	Kennedy pers. comm., 1993
1993	0.847 \pm 1.06	1.00 \pm 1.08	20	1.82 \pm 0.75	11	New Mexico	Kennedy pers. comm., 1993
1979-80		3.75 \pm 0.50	4	3.75 \pm 0.50	4	Utah	Lee 1981
1971		2.5		3.0		Alaska	McGowan 1975
1972		1.8		2.3		Alaska	McGowan 1975
1973		1.8		2.9		Alaska	McGowan 1975
1992		1.62 \pm 1.19	13	2.10 \pm 0.88	10	California	Morrison and Keane 1994
1993		0.93 \pm 0.92	14	1.63 \pm 0.52	8	California	Morrison and Keane 1994
total		1.26 \pm 1.10	27	1.89 \pm 0.76	18	California	Morrison and Keane 1994
1974				1.50		Nevada	Oakleaf 1975
1975				2.50		Nevada	Oakleaf 1975

Years	Mean Young per Occupied Nest	Mean Young per Active Nest	No. Active Nests	Mean Young per Successful Nest	No. Successful Nests	Location	Source
1969		1.50				Oregon	Reynolds 1975
1970		1.80				Oregon	Reynolds 1975
1971		1.60				Oregon	Reynolds 1975
1972		1.90				Oregon	Reynolds 1975
1973		1.50				Oregon	Reynolds 1975
1974		2.00				Oregon	Reynolds 1975
total		1.70 ± 0.76	48			Oregon	Reynolds 1975
1991	1.97 ± 0.83	2.03 ± 0.77	36	2.15 ± 0.61	34	Arizona	Reynolds <i>et al.</i> 1993
1992	1.74 ± 1.08	1.80 ± 1.05	59	2.16 ± 0.72	49	Arizona	Reynolds <i>et al.</i> 1993
1993	1.54 ± 1.04	1.69 ± 0.97	62	1.94 ± 0.76	54	Arizona	Reynolds <i>et al.</i> 1993
total	1.71 ± 1.02	1.81 ± 0.96	157	2.07 ± 0.71	137	Arizona	Reynolds <i>et al.</i> 1993
1984-92		1.93	84			California	Woodbridge & Detrich 1994
1991		1.29 ± 1.38	14	2.25 ± 1.04	14	Nevada	Younk 1994
1992		2.77 ± 0.92	22	2.90 ± 0.70	21	Nevada	Younk 1994
1993		2.00 ± 1.19	25	2.38 ± 0.86	21	Nevada	Younk 1994
total		2.11 ± 1.27	61	2.58 ± 0.86	50	Nevada	Younk 1994

Correlates of reproduction

Productivity has been correlated with both extrinsic and intrinsic factors. Extrinsic factors include human disturbance (Hennessy 1978), timber harvest (Crocker-Bedford 1990), and food availability (McGowan 1975, Huhtala and Sulkava 1981, Linden and Wikman 1981, Sulkava 1981). Sample sizes in Hennessy (1978) were too small to draw meaningful conclusions about the effects of human disturbance on reproduction. Crocker-Bedford (1990) reported that timber harvest caused over a 90 percent reduction in reproduction of goshawks in northern Arizona, but his conclusions are contradicted by more recent data from the same population (Reynolds *et al.* 1994, Reynolds and Joy 1998). For the same study area, Reynolds and Joy (1998) found productivity relatively constant among years, ranging from 1.2 to 2.0 young per nest per year.

In North America, the number of breeding pairs and productivity has been related to the number of snowshoe hares for populations in northern latitudes (McGowan 1975, Doyle and Smith 1994). Wikman and Linden (1981) and Linden and Wikman (1983) reported declines in goshawk populations and reproductive success coinciding with declines in grouse abundance. However, when prey populations increased, goshawk numbers remained low. Declines in reproductive success were attributed primarily to non-breeding or early nest failure, while brood sizes remained fairly constant.

Intrinsic factors include the age and condition of breeding birds. Condition was estimated by the amount of fat present on the keel for birds in northern Arizona (Reynolds *et al.* 1994). Although differences in productivity were not significant, the trend was in the direction expected. Age, however, was significantly related to productivity. Reynolds *et al.* (1994) showed that pairs in which at least one member was a young adult produced significantly fewer young than pairs from which both members were known to be full adults. The difference was due primarily to the higher failure rate of pairs composed of young adults.

Survival

Adult survival estimates are available from two studies in North America and two in Europe. Reynold and Joy (1988) estimated adult survival for goshawks in northern Arizona using capture-recapture methodology and model selection procedures outlined in Lebreton *et al.* (1992). Estimates of apparent survival were 0.688 (SE= 0.0618) and 0.866 (SE= 0.0514) for males and females, respectively.

DeStefano *et al.* (1994) calculated adult survival rates for goshawks in northern California using the same methodology, which yielded point estimates of apparent survival of 0.61 (SE= 0.05) for males and 0.69 (SE= 0.09) for females. However, the authors point out that these estimates are imprecise due to the small sample of marked birds and low resighting values. They further point out that the estimates produced were likely biased low because some marked birds emigrated off the study area and only birds that were associated with successful nests were resighted.

Population Status and Trend

Introduction

Goshawks are difficult to survey and detect (Joy *et al.* 1994, Reynolds and Joy 1998). The accuracy of many past conclusions regarding the status of local goshawk populations is strongly affected by the adequacy or inadequacy of surveys and area-wide census efforts. Goshawks are

cryptic and highly mobile with large home ranges and are difficult to detect in densely forested habitats (Reynolds 1982). (A complete discussion of survey protocols is available in the Service's Status Review.) Consequently, goshawk numbers reported to the Service for its Status Review were interpreted with caution. Surveys tend to focus on project areas (e.g., timber sale areas) and thus rarely achieve complete coverage of a given administrative unit.

Even for surveyed areas, the data are confounded by two primary and opposing factors: 1) because goshawks build multiple alternate nests, the number of pairs is often overestimated; and, conversely, 2) because goshawks can be difficult to detect and many are never located, the number of pairs can be underestimated. Because goshawks usually have alternative nests within a territory, a given territory should not be considered unoccupied or abandoned simply because a previously active nest was found to be unoccupied during a given year, unless significant time was spent in locating possible alternative nests within that territory and none were found. Considerable survey effort is needed to prove a pair has abandoned the territory, and not simply moved to an alternative nest within that territory. Estimating goshawk populations is difficult and labor-intensive because hawks must be individually marked, and considerable time and effort expended, as described by Reynolds and Joy (1998). Territory numbers reported for the Status Review are used with caution because they are based on agency databases which include historical sites that may no longer exist (e.g., burned, logged, no recent occupancy), may not be complete and up-to-date, may include locations that have not been verified and may include duplicate records due to reporting from different sources. For some of these reasons, the Status Review did not analyze the complete set of reported territories (3,242 sites). Instead, the analysis looked at a subset of territories (2,729 sites) for which many of the problems listed above could be addressed.

While the Service approached the territory data reported for the Status Review with caution, it is important to note that approximately 75 percent of the territories reported were first located in the past 10 years. This large percentage is reflective of the increase in survey effort that Federal agencies implemented in the 1990s, and is consistent with the Service's expectation that as survey efforts improve, more goshawk territories will be documented throughout the western United States.

Population Data from Intensive Studies

Several long-term studies on various aspects of northern goshawk ecology and management have been or are being conducted within the Status Review Area, including areas in the following Forest Service reporting units: Ashley National Forest, Utah (5 years); Santa Fe National Forest, New Mexico (12 years); Kaibab National Forest, Arizona (7 years); Klamath and Modoc National Forests, California (14 years); Medicine Bow National Forest, Wyoming (5 years); and Targhee National Forest, Wyoming (7 years).

Comparing the data from these long-term study areas against the surrounding Assessment Area in which each occur, we find a greater number of territories were reported per acre, and proportionally more active nests are found in the study areas. This observation is consistent with, and helps to confirm, our expectation that more territories are usually documented in areas where more search effort is expended, up to the point at which the entire area has been fully searched. This is important in light of the high percentage (70%) of territory-years with insufficient or no survey effort reported to the Status Review Team. We can infer that if a commensurate amount of effort were expended in the other areas, we would see an increase in reported numbers of

goshawk territories and an increase in documented goshawk nesting.

Data from Counts and Surveys

Migration counts from long-term count sites, such as those conducted by HawkWatch International, show high variability in the numbers of goshawks (Table 1). As previously discussed, goshawks are largely nonmigratory, with most adults remaining on their territories year-round except during years of low prey availability. Bednarz *et al.* (1990) and Titus and Fuller (1990) suggest that changes in goshawk populations may not be accurately assessed in migration counts because goshawk migrations are irruptive, a factor that may mask population trends.

The Breeding Bird Census (BBC) is another potential source of population trend data. The BBC program is based on individual study plots established within a single habitat type. Standardized methods are followed to collect data on the avian and vegetative communities. Over time, BBC data may provide insight into the changes occurring in breeding avifauna within these communities. Limitations of BBC data include: biased selection of study plot locations, inadequate sampling of all the habitats and avian communities in an area, inability to represent temporal changes in bird communities over a larger area, and inability to distinguish differences in bird communities between plots due to differences in plot size, geography, structure, and composition. Johnson (1990) detailed additional factors to consider when examining data from individual plots, including aperiodicity of data from some plots, annual variation in census effort, and changes in observer competency over time. Due to all of these limitations, the Review Team did not utilize data from the BBC for the purposes of this Status Review.

The Breeding Bird Survey (BBS) is another source of information on long-term population trends for the northern goshawk. The BBS is based on fixed routes that are usually driven by automobile, with fixed observation points. Because of the ecology and natural history of the northern goshawk, BBS data are insufficient for this cryptic, forest-dwelling species. This is a species that is not likely to be detected from roadside observation points, therefore, it is unlikely that the sample size of birds encountered would increase with more BBS routes (Saab and Rich 1997). Consequently, the Service did not include BBS data.

The Christmas Bird Count (CBC) is another potential source of data. The CBC is a day-long bird census occurring within a 15-mile circle. In late 1950s, the National Audubon Society implemented uniform standards for conducting the CBC. With nearly a century of data in some cases, the CBC is a valuable source of information on historic and recent changes in the status and distribution of birds during the early winter period in the United States and Canada. CBCs tend to be concentrated near cities, are more numerous in the eastern United States, and tend to be located near areas where large numbers of birds are concentrated during that season of the year. Butcher (1990) discussed several biases and limitations of CBC data. As with the other national monitoring data sets, the Service concluded that it would be inappropriate to interpret and infer goshawk populations trends from CBC data.

Assessment Area 1

Status of goshawk populations in Assessment Area 1

Assessment Area 1 includes the State of Montana, parts of North Dakota and South Dakota, and the northern half of Idaho. The goshawk population in Assessment Area 1 is poorly represented in the published research, with only one research study found in the Area (Table 12).

Table 12. Published and unpublished goshawk field studies conducted, or in progress, in Assessment Area 1.

Source	Type	Location	Topic(s)
Hayward and Escano 1989	published paper	northern Idaho, western Montana	nest tree and nest stand characteristics

Distribution and Reported Numbers

Goshawks are widely distributed across the forested habitat in this Assessment Area (Figure 3) and we believe this distribution is similar to the historic range of the species, and there is no documented evidence of extirpation from any portion of this assessment area.

Most reported goshawk surveys in the Assessment Area have been conducted on Forest Service lands (84% of the reported territories, managing 71% of the potential goshawk habitat). The BLM reported 9% of the territories, as did private and other landowner categories (Table 13). Because 18% of the reported goshawks occur on non-Forest Service lands, these lands are important to the long term management of the species.

Of the five land management units that reported survey summary information to the Status Review, two gave estimates of the proportion of their unit which had been surveyed. The Lolo National Forest estimated 20% of the Forest had been surveyed between 1992 and 1997 using the ‘Kennedy protocol,’ resulting in the location of as many as 9 territories that had not previously been documented. The Clearwater National Forest estimated that 300 miles of road routes (roughly equivalent to 10% of the Forest), had been surveyed in 1993 using the ‘Kennedy protocol,’ resulting in the location of as many as 3 new territories. Other Forests did not report an estimate of their survey effort, but did report goshawk territory locations (Table 13).

Population Status

There is no information available to directly assess historical goshawk population trends in Assessment Area 1. However, based on assessment of historical habitat changes (see Factor A below), it is reasonable to conclude that goshawk populations may have been reduced from historical levels, although the magnitude of population change is unknown. Goshawks are probably less abundant in areas that have been more heavily logged or affected by wildfires, but we have no survey or research results to document this conclusion. While goshawk abundance has likely changed, goshawk distribution in Assessment Area 1 is probably similar to pre-settlement times, and we have no evidence of areas where the species has been extirpated.

Figure 3. Numbers of Northern Goshawk Territories Reported In Assessment Area 1

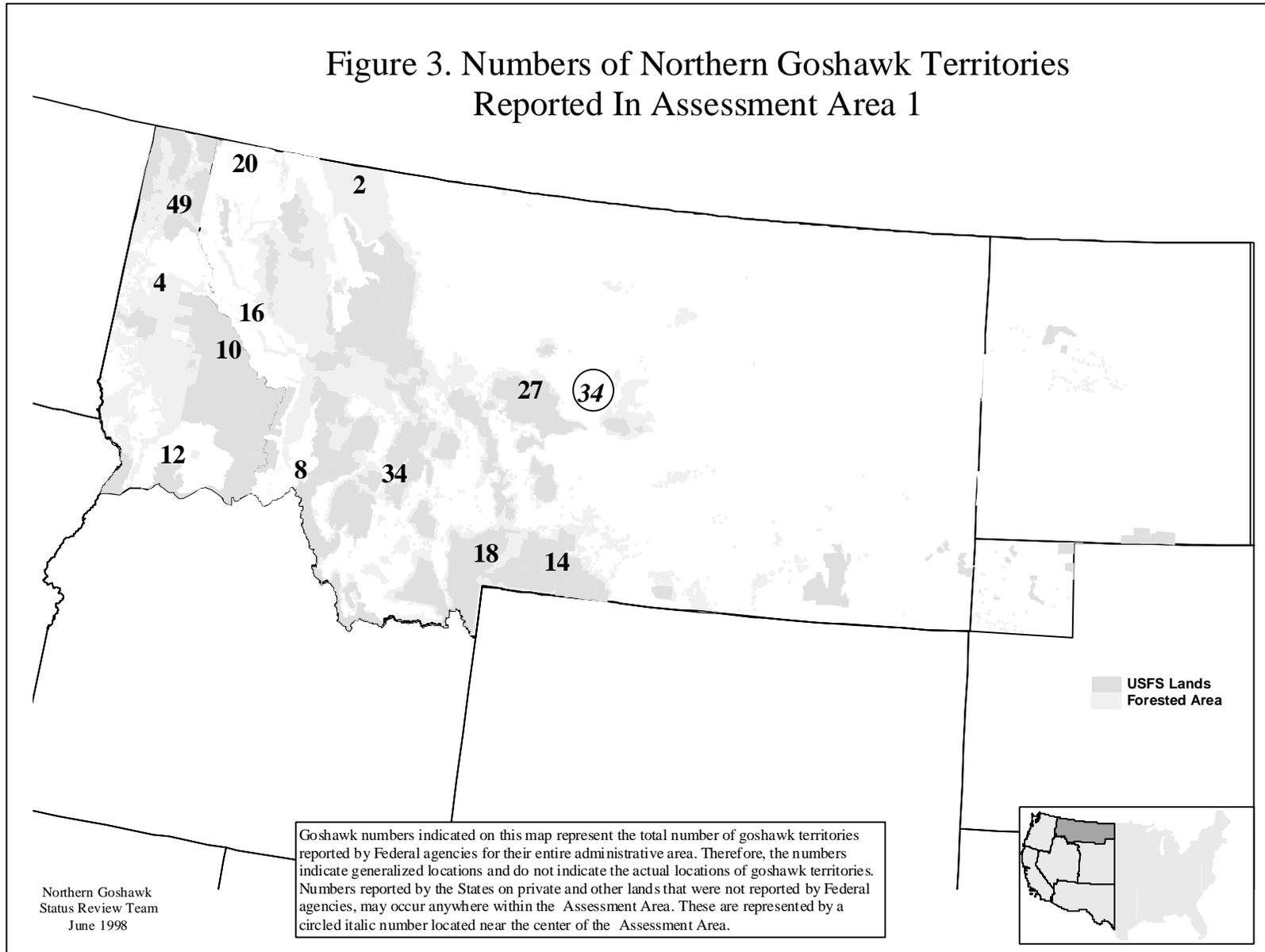


Table 13. Goshawk territories reported to the Status Review Team by land management agencies and state natural heritage programs in Assessment Area 1.

State	Landowner	No. Territories¹
Idaho	Clearwater National Forest	10
	Idaho Panhandle National Forests	49
	Nez Perce National Forest	12
	Nez Perce National Historical Park	1
	Bureau of Land Management, Coeur d'Alene Field Office	4
Subtotal:		76
Montana	Beaverhead-Deerlodge National Forests	34
	Bitterroot National Forest	8
	Custer National Forest	14
	Gallatin National Forest	18
	Kootenai National Forest	20
	Lewis and Clark National Forest	27
	Lolo National Forest	16
	Glacier National Park	2
	Montana State Dept of Natural Resources	6
	Various, including private lands	16
	Bureau of Land Management, Garnet Field Office	7
	Bureau of Land Management, Dillon Field Office	4
Subtotal:		172
TOTAL:		248

The goshawk is a Species of Special Concern in both Idaho and Montana. Forest Service Region 1 evaluated the goshawk for listing as a sensitive species in 1988 and 1991. In both of these evaluations the agency concluded the goshawk did not meet the criteria that would support listing the species as sensitive.

Thus, there are mixed indications of the level of concern for goshawk in Assessment Area 1. Despite these agency designations, there is no documentation that the species is declining in this Area.

Conclusion

It is reasonable to conclude that the goshawk population has declined in the Assessment Area when looking at habitat changes since pre-settlement times. However, goshawks appear to remain widely distributed throughout this area, and there are no data to indicate any extirpation or

current, ongoing decline.

Assessment Area 2

Status of goshawk populations in Assessment Area 2

Assessment Area 2 includes the states of Colorado, Wyoming, most of South Dakota and Nebraska. Information on the goshawk population in Assessment Area 2 is primarily represented in five published research reports (Table 14).

Table 14. Published and unpublished goshawk field studies conducted, or in progress, in Assessment Area 2.

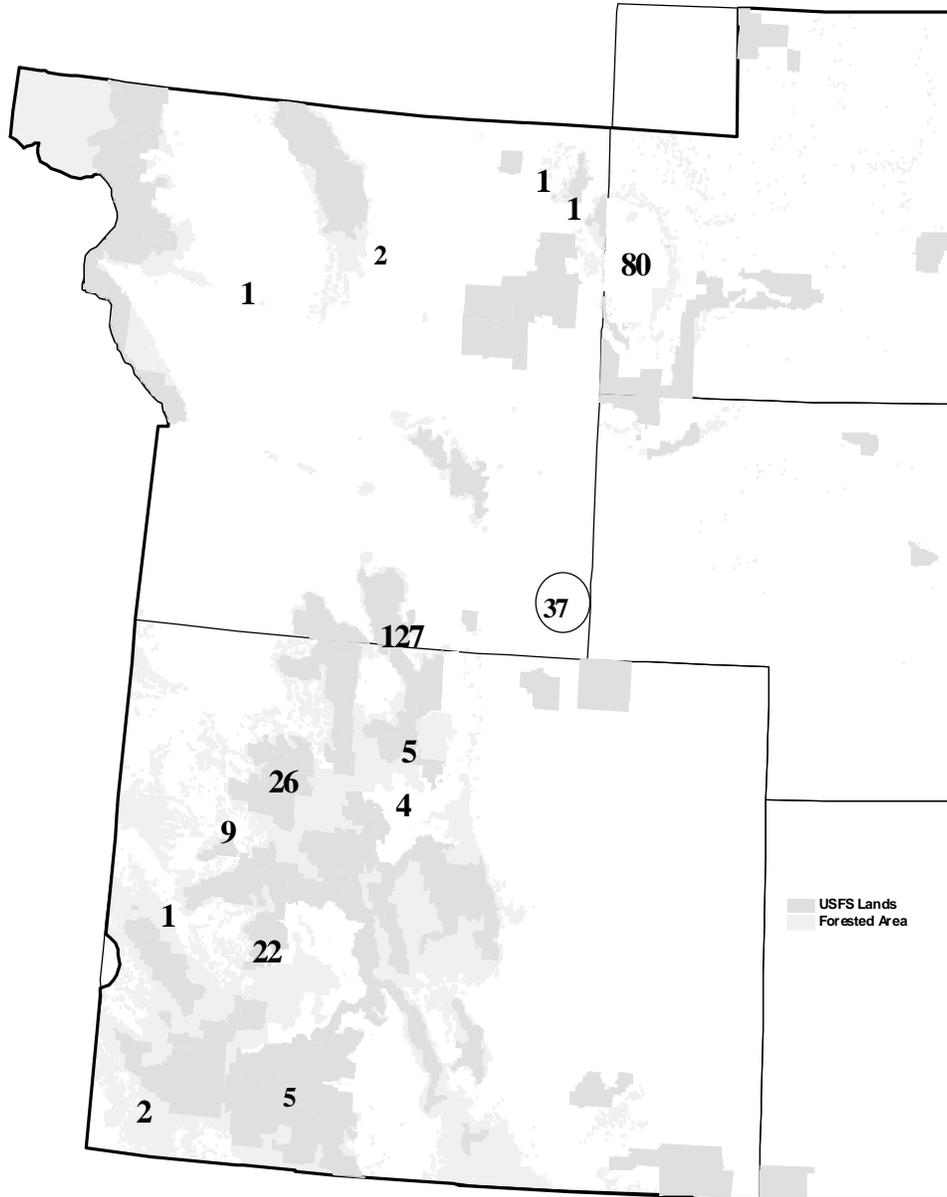
Source	Type	Location	Topic(s)
White, Lloyd and Richards 1965	published paper	near Dinosaur NP	nest site in Upper Sonoran vegetation zone
Doerr and Enderson 1965	published paper	Colorado Springs	winter abundance index
Shuster 1980	published paper	Arapaho and Roosevelt NFs and Rocky Mtn. NP	nest-site habitat characteristics
Squires and Ruggiero 1995	published paper	Southcentral Wyoming and Colorado	winter movements, migration
Squires and Ruggiero 1996	published paper	Medicine Bow NF	nest-site habitat characteristics

Distribution and Reported Numbers

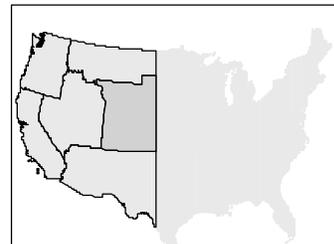
Goshawks are widely distributed across the forested habitat of this Assessment Area (Figure 4) and we believe this distribution is similar to the historic range of the species. Like within other Assessment Areas, there was a temporary increase in survey effort in 1992-93 (Figure 5). Most reported goshawk surveys in the Assessment Area have been conducted on Forest Service lands (84% of the reported territories, managing 61% of the potential goshawk habitat). The BLM reported 4% of the territories. Private and other landowner categories reported 11% of the sites (Table 15). Because 15% of the reported goshawks occur on non-Forest Service lands, these lands may be important to the long term management of the species.

Review of the history of the reported territories shows that 72% of the reported territories have been documented in the past seven years as a result of increased survey effort.

Figure 4. Numbers of Northern Goshawk Territories Reported In Assessment Area 2



Goshawk numbers indicated on this map represent the total number of goshawk territories reported by Federal agencies for their entire administrative area. Therefore, the numbers indicate generalized locations and do not indicate the actual locations of goshawk territories. Numbers reported by the States on private and other lands that were not reported by Federal agencies, may occur anywhere within the Assessment Area. These are represented by a circled italic number located near the center of the Assessment Area.



Northern Goshawk
 Status Review Team
 June 1998

**Territories First Reported as Occupied by Year
Assessment Area 2 Vs. Status Review Area**

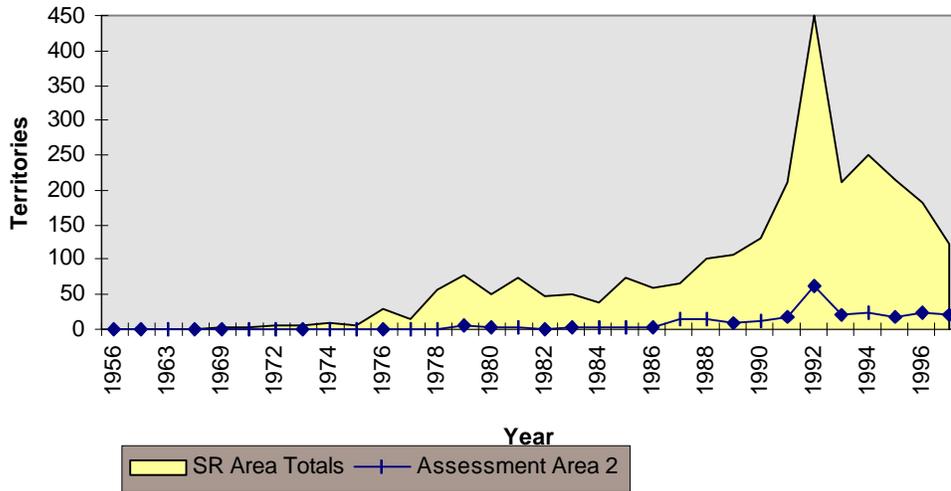


Figure 5. Goshawk territories reported to the Status Review, as reflected by the first year of occupancy

Table 15. Goshawk territories reported to the Status Review Team by land management agencies and state natural heritage programs in Assessment Area 2.

State	Landowner	No. Territories
CO	Arapaho and Roosevelt National Forest	4
	Grand Mesa, Uncompahgre, and Gunnison National Forest	22
	San Juan-Rio Grande National Forest	5
	White River National Forest	26
	Florissant Fossil Beds National Monument National Park Service	1
	Mesa Verde National Monument National Park	2
	Rocky Mountain National Park	5
	Bureau of Land Management: Glenwood Springs Field Office	9
	Bureau of Land Management: Grand Junction Field Office	1
	Colorado State: Forest Service	8
Subtotal:		83
SD	Black Hills National Forest	80
Subtotal:		80
WY	Medicine Bow-Routt National Forest	127
	Devils Tower National Monument National Park Service	1
	Bureau of Land Management: Buffalo Field Office	2
	Bureau of Land Management: Newcastle Field Office	1
	Bureau of Land Management: Worland District Office	1
	Monarch Wildlife Consultants	6
	Wyoming Natural Heritage Diversity Database	6
	Wyoming State: Forestry Division	4
	Wyoming State: Game and Fish Department	12
Subtotal:		160
TOTAL		323

Population Status

There is no information available to directly assess historical goshawk population trends in the Assessment Area. There is very little information on historical habitat changes on which to base conclusions for goshawk populations. Goshawks in areas that have been more heavily logged or

affected by wildfires are probably less abundant now as compared to historical trends, but we have no survey or research results to document this conclusion. While goshawk abundance may have changed, goshawk distribution in Assessment Area 2 is probably similar to pre-settlement times, and we have no evidence of areas where the species is declining or has been extirpated.

Conclusions

It is reasonable to conclude that there may have been declines in goshawk populations in the Assessment Area when looking at habitat changes since pre-settlement times. However, goshawks continue to be well distributed across this area, and there is no evidence to indicate any extirpation or ongoing declines.

Assessment Area 3

Status of goshawk populations in Assessment Area 3

Assessment Area 3 includes the states of Arizona, New Mexico, and parts of western Oklahoma and Texas.

Introduction

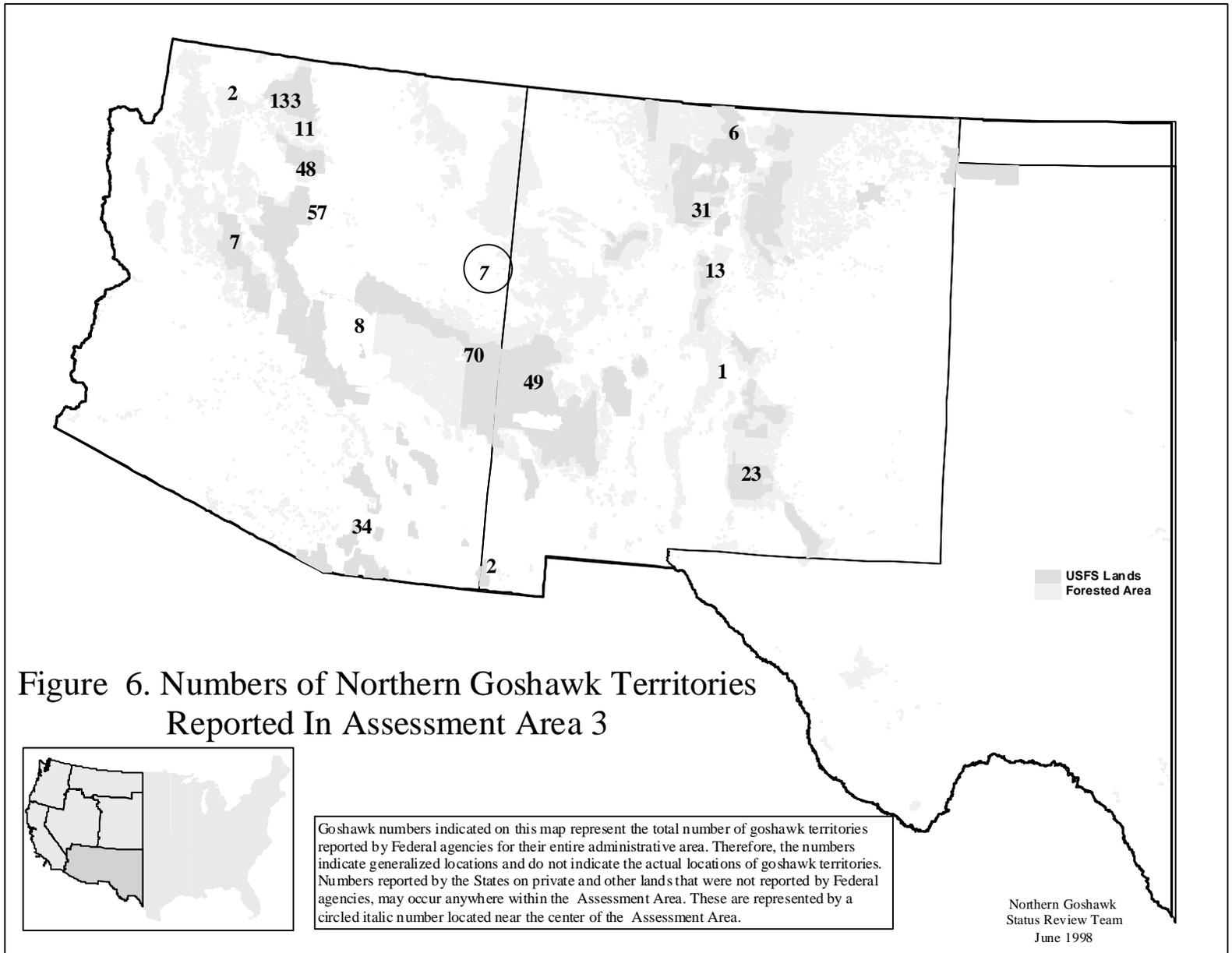
Over the last 20 years, numerous goshawk studies have been conducted in the Southwest. These studies have addressed a wide array of topics, ranging from describing habitat characteristics to estimating demographic parameters (Table 16). Although all of these studies have addressed important aspects of goshawk ecology, only two (Ingraldi 1998, Reynolds and Joy 1998) directly contribute to assessing goshawk population status and trends. Both studies are in progress.

Distribution and Reported Numbers

Goshawks are widely distributed across the Southwest (Figure 6). There are breeding records from all major mountain ranges, as well as smaller sky islands, generally above 6,000 feet in elevation (Snyder and Snyder 1998). In the Southwest, the goshawk's winter range is believed to be similar to its breeding range, although there is some irregular movement of individuals, particularly immature birds, generally to lower elevations (P. Hall unpubl. data, Reynolds unpubl. data, Reynolds *et al.* 1994, Beier 1997a, Ingraldi 1998).

Table 16. Published and unpublished goshawk studies conducted or in progress in Arizona and New Mexico. Multiple papers or reports may have resulted from the same study. Since the intent is to display an overview of the number of different studies (vs. number of publications), generally only the most complete or most recent publication or report is cited.

Source	Type	Location	Topic(s)
Beier 1997a	report	Coconino NF, AZ	winter foraging habitat
Beier 1997b	report	Coconino NF, AZ	fledgling survival and movements
Beier and Drennan 1997	published paper	Coconino NF, AZ	summer foraging habitat
Boal and Mannan 1994	published paper	Kaibab NF, AZ	diet, productivity
Bright-Smith and Mannan 1994	published paper	Kaibab NF, AZ	home range, habitat use
Crocker-Bedford and Chaney 1988	published paper	Kaibab NF, AZ	habitat characteristics
Crocker-Bedford 1990	published paper	Kaibab NF, AZ	effects of timber harvest on occupancy and productivity, density
Gavin and May 1996	report	AZ	genetics, taxonomy
P. Hall, pers. comm.	unpublished data	Coconino NF, AZ	home range
Hubbard 1992	report	Southwest	taxonomy
Ingraldi 1998	draft report	Sitgreaves NF, AZ	demography, ecology
Ingraldi and MacVean 1995	report	Sitgreaves NF, AZ	habitat selection
Kennedy 1989	report	Santa Fe NF, NM	reproductive success, density, habitat characteristics, food habits
Kennedy <i>et al.</i> 1994	published paper	Santa Fe NF, NM	dispersal, post-fledging areas, home range
Luckett 1978	report	AZ	habitat characteristics
Reynolds and Joy 1998	report	Kaibab NF, AZ	demography, ecology
Snyder 1995	report	Coronado NF, AZ	distribution, productivity, habitat characteristics, diet
Siders and Kennedy 1996	published paper	Santa Fe NF, NM	habitat characteristics
Ward and Kennedy 1996	published paper	Santa Fe NF, NM	supplemental feeding
Ward <i>et al.</i> 1992	report	Kaibab NF, AZ	habitat changes and reproduction



Most goshawk surveys in the Southwest have been conducted on Forest Service lands (e.g., Russo 1976 and 1977, Todd 1978, Luckett and Todd 1982, Tibbitts *et al.* 1988, Tibbitts and Zinn 1989, Zinn and Tibbitts 1990, Dargan 1991, Beatty 1992, McGuinn-Robbins and Ward 1992, Heslin *et al.* 1993, Driscoll and MacVean 1994, Lutch 1996, Reynolds and Joy 1998) beginning in the 1970s, but with most occurring since 1991 when the Forest Service first issued regional goshawk guidelines (Reynolds *et al.* 1992, Fletcher and Sheppard 1994, USDA Forest Service 1995). Surveys have followed a standard inventory protocol based on Kennedy and Stahlecker (1991, 1993) and Joy *et al.* (1994). A disproportionate number of these surveys have occurred on a single ranger district, the North Kaibab Ranger District, in northern Arizona, which is now the focus of the largest goshawk demography study (Reynolds and Joy 1998) throughout the species' range. A few surveys have also been conducted on other lands (e.g., NPS: Berner and Mannan 1992, Driscoll and MacVean 1994; BLM: Driscoll and MacVean 1994; tribal lands: Moors 1996, Reynolds and Joy 1998).

In February 1997, in an attempt to more reliably estimate the number of known goshawk pairs in Arizona, the Arizona Game and Fish Department surveyed land management agency biologists (M. Ingraldi, pers. comm. 1998). Biologists were asked to provide the number of northern goshawk territories that had been active (i.e., eggs laid) at least once since 1990. The total number of territories reported for Arizona in this survey (292) was lower than that reported to the Service for the Status Review (377, Table 17). Biologists were also asked to estimate the proportion of ponderosa pine and higher elevation forest that had been surveyed for goshawks. This estimate ranged from 50-75%. Thus, this estimated number of goshawk territories (292) should be viewed as a minimum estimated number of goshawk pairs in the state.

In May 1998, additional information was received from New Mexico Department of Game and Fish (A. Sandoval, Santa Fe, pers. comm. 1998) including the Department's tally of goshawk territories in New Mexico through 1997. Their estimate was 145 (vs. 125, Table 17); however, it was not qualified in any way so the Team could not determine whether this estimate included historical and unverified territories. Also, we have no estimate for what proportion of New Mexico's forested habitat has been surveyed for goshawks, but it may be lower than for Arizona. Thus, the Arizona and New Mexico state agency estimates combined indicate there are 437 (vs. 502, Table 17) known goshawk territories, and again, should be viewed as a minimum estimate of the number of goshawk pairs in the Southwest.

Table 17. Goshawk territories reported by land management agencies and state natural heritage programs in Assessment Area 3.

State	Landowner	No. Territories ¹
AZ	Kaibab National Forest: North Kaibab	133
	Kaibab National Forest: South Kaibab	48
	Apache-Sitgreaves National Forests	70
	Coconino National Forest	57
	Coronado National Forest	34
	Grand Canyon National Park	11
	Tonto National Forest	8
	Prescott National Forest	7
	Bureau of Land Management: AZ Strip Field Office	2
	various, including private lands	7
Subtotal:		377
NM	Gila National Forest	49
	Santa Fe National Forest	31
	Lincoln National Forest	23
	Cibola National Forest	13
	Carson National Forest	6
	Coronado National Forest	2
	Bureau of Land Management: Socorro Field Office	1
Subtotal:		125
TOTAL:		502

¹Territory numbers reported in this table may not match numbers reported elsewhere in the document. This table includes territories reported directly by landowners supplemented with state natural heritage program database information to fill in gaps. Also, these territories have not been screened for territory validity. See text for any such adjustments.

Population Status

Historical Trends

There is no information available to directly assess historical goshawk population trends in the Southwest. However, based on assessment of historical habitat changes (see Factor A below), it seems reasonable to conclude that goshawk populations have been reduced from historical levels, although the magnitude of population change is unknown. Goshawks may be less abundant in areas that were historically railroad logged (e.g., Apache-Sitgreaves and Coconino National Forests), but may occur at levels similar to historical densities elsewhere in the Southwest (e.g., Coronado National Forest, North Kaibab Ranger District). While abundance may have changed, there is no clear evidence of this, and goshawk distribution in the Southwest is probably similar to

pre-settlement times.

Current Status

The northern goshawk is afforded special status in the Southwest. It has been a Forest Service sensitive species since 1982 (USDA Forest Service 1991) and an Arizona Game and Fish Department species of special concern since 1988 (AZ Game and Fish Dept. 1988 and 1996). Over the last decade, concerns over changes in forest habitats in the Southwest, and the viability of northern goshawk populations, have been expressed by some scientists and the public (e.g., Kennedy 1989, Crocker-Bedford 1990, Zinn and Tibbitts 1990, Reiser 1991, Silver *et al.* 1991). In 1990, in response to growing concerns, the Regional Forester conducted an internal status review on the goshawk and later formed the Goshawk Scientific Committee (GSC). The GSC's charge was to develop a credible management strategy to conserve the goshawk in the Southwest. In their management recommendations (Reynolds *et al.* 1992), the GSC acknowledged that past forest management practices (primarily harvest of mature and old growth forest stands) had altered goshawk nest area habitat and implied that goshawk populations had been reduced.

Several recent reviews of available information have discussed, and in a few cases attempted to assess, the status or viability of goshawk populations, including those in the Southwest (e.g., Maguire and Call 1993, Block *et al.* 1994, White 1994, Braun *et al.* 1996, Kennedy 1997). These reviews have generally pointed out that there is no evidence to indicate a decline in goshawk populations. However, it is important to note that there is also no evidence to support an increase, nor to support a conclusion that goshawk populations are stable in the Southwest. Ongoing demography studies aim to answer this question for two Arizona goshawk populations (Ingraldi 1998 and Reynolds and Joy 1998). However, neither study has collected data for a sufficient number of years to adequately assess goshawk population trends at this time.

Reynolds and Joy (1998) began their study in 1991 on the Kaibab Plateau in northern Arizona. This study is the largest goshawk demography study, both in terms of population size as well as total effort expended. A few salient points, based on data collected to date, include: 1) the breeding density estimate for the Kaibab Plateau population (11.9/100 sq km) is the highest reported for the species; 2) the available habitat appears saturated, and; 3) the adult population appears relatively stable (Reynolds and Joy 1998).

In 1993, the Arizona Game and Fish Department (Ingraldi 1998) initiated a second study in response to one of Maguire and Call's (1993) recommendations. Maguire and Call (1993) failed to collect sufficient demographic data to conduct a population viability analysis for the Kaibab Plateau population and recommended that a study similar to that on the Kaibab be carried out in at least one other area. The Sitgreaves National Forest was selected because surveys had identified a relatively high number of breeding territories and the habitat was more representative of Arizona ponderosa pine forests. Unlike most ponderosa pine forests in the Southwest, the Kaibab Plateau was not logged extensively by railroad companies in the late 1880's and early 1900's, and is still largely dominated by mature trees. This makes the Kaibab Plateau unique in Arizona and in the Southwest. The Kaibab Plateau is judged by some to provide the best goshawk habitat in ponderosa pine across the pine's range (R. Reynolds, USDA Forest Service, Fort Collins, pers. comm. 1998).

Ingraldi's (1998) overall study area on the Sitgreaves National Forest is almost twice as large as

Reynold's in size (1276 square miles (sq mi) vs. 669 sq mi), but has less than half the number of known goshawks. Ingraldi has 42 known territories and estimates 50 may occur on the area; Reynolds has 108 known territories and estimates 146. However, it is unclear to the Service whether the survey effort of Ingraldi is comparable to the intensive survey effort of Reynolds and Joy; if not, then the reported number of known sites on the Ingraldi study area may not be as accurate as that on the Reynolds and Joy study area. Reynolds (pers. comm. 1998) indicates that on their Kaibab study area they have employed two to three times more survey staff each year than Ingraldi has been able to employ, ostensibly allowing a more intensive and larger-scale search of the Kaibab study area. A smaller number of birds on Ingraldi's study area is not necessarily unexpected given the forest management history of ponderosa pine forests on the Sitgreaves study area, including heavy railroad logging through the early part of this century. Demographic data have been collected for five years (1993-1997). At this time, the precision of demographic parameter estimates (e.g., adult survivorship) is too low to adequately statistically determine a rate of population change. This is due primarily to the fact that too few marked birds have been resighted. Also, the past 5 years were not expected to encompass the full range of variation in these parameters; several more years of data collection should improve the precision of demographic parameter estimates.

As part of his 5-year report, Ingraldi (1998) performed a sensitivity analysis which revealed that adult survivorship, and not fecundity or juvenile survivorship, is the key parameter to the viability of this central Arizona population. This is similar to findings for other raptors (e.g., peregrine falcons, Wooten and Bell 1992; northern spotted owl, Noon and Biles 1993).

Based on data collected to date on the Sitgreaves, Ingraldi (1998) noted that the number of fledglings per active nest was lower and the failure rate higher than averages reported for other western goshawk populations. When similar years of study for the Sitgreaves and Kaibab are compared (1993-1996), activity rate patterns have been similar (e.g., lows and highs have occurred in the same years). Preliminary data from Ingraldi (1998) suggest that the Sitgreaves population may be unstable, although additional data and analysis are needed to determine if an ongoing decline on the Sitgreaves may be occurring.

Conclusion

It is reasonable to conclude that there may have been local declines in goshawk populations in the Southwest when compared to pre-settlement times. Although two long-term studies have been conducted, for 5 and 7 years, neither of these studies have adequate data to statistically calculate a rate of population change. At the present time, goshawks on the North Kaibab appear to be stable and the available habitat saturated. On the Sitgreaves, goshawks may be exhibiting signs of decline, although this is yet to be determined. The results of these studies are site-specific and not necessarily representative of the Southwest in general, and it may not be appropriate to extrapolate these results across the Southwest. In this assessment area in general, the goshawk appears to remain well distributed, and there is no data to indicate any extirpation.

Assessment Area 4

Status of Goshawk Populations in the Intermountain Assessment Area

Assessment Area 4 includes the states of Nevada, Utah, the southern half of Idaho and the southwest corner of Wyoming.

Introduction

Assessment of goshawk populations in the Intermountain Assessment Area was attempted based on review of available literature and ongoing studies, and analysis of goshawk data provided by land management agencies and others (Table 18). A number of agency reports, master's theses, doctoral dissertations, and research publications incorporate northern goshawk data obtained within Assessment Area 4. Although these studies addressed a number of topics, ranging from effects of human disturbance to large-scale habitat modeling, none directly assess goshawk population and trends throughout the Intermountain Assessment Area. Figure 7 shows the numbers and relative distribution of goshawks reported.

Distribution and Reported Numbers

Systematic surveys for goshawks have not been conducted at a large scale within the Intermountain Assessment Area, and the majority of territories were discovered during timber sale surveys, Mexican spotted owl surveys, or incidentally to other activities. Surveys tend to focus on proposed project areas (e.g., timber sale areas) and thus rarely achieve complete coverage of a given administrative unit. Because no large areas within Assessment Area 4 receive systematic goshawk surveys, numbers of territories reported here should be considered a minimum. Despite concerns associated with these data, the total of 602 goshawk territories reported in Table 19 below, as reported for the Status Review, provides the best currently available estimate of the general distribution and relative abundance of goshawk pairs within the Intermountain Assessment Area.

Population Status

Historical Trends

There is no information available to directly assess historical northern goshawk population trends in the Intermountain Assessment Area. However, based on assessment of habitat changes leading to current estimated risk of departure from historical functioning condition (see Factor A below), we conclude that goshawk populations may have been reduced from historical levels, though the magnitude of such change is unknown. Caution must be exercised, however, in the direct application of trends in forest type to trends in goshawk population. While abundance may have changed in parts of the Assessment Area due to major landscape changes due to various factors (e.g., catastrophic fire, insect outbreak, as discussed in the Habitat section of this finding), it is likely that goshawk distribution in the Intermountain Assessment Area is similar to pre-settlement times, as the species is widespread in the Assessment Area.

Current Status

In 1991, the northern goshawk was designated as a sensitive species for Forest Service Region 4. The management recommendations developed by the Goshawk Scientific Committee (GSC) (Reynolds *et al.* 1992) for the Southwest Region of the Forest Service were also adopted by Region 4 of the Forest Service in 1992.

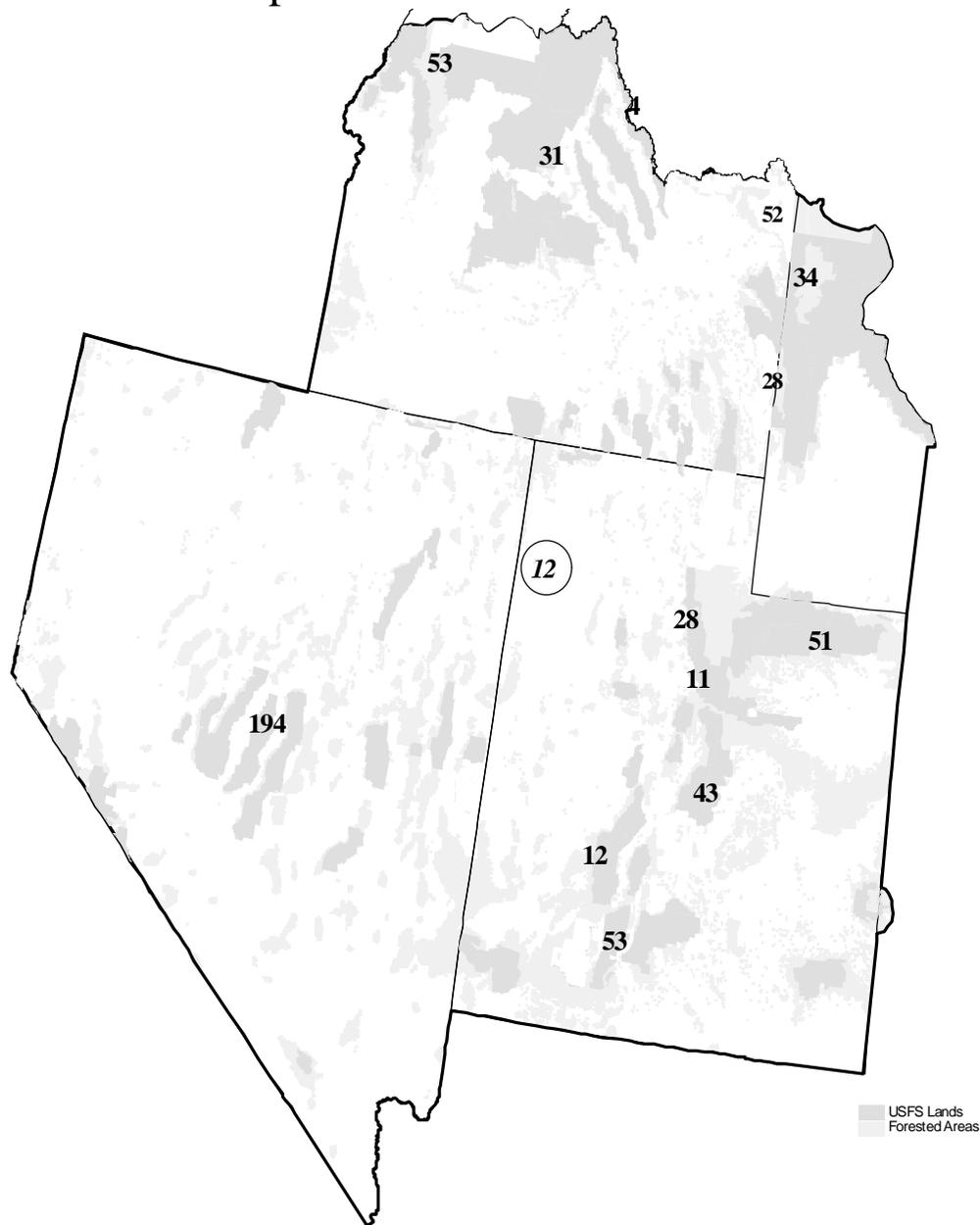
Population data available for the Status Review were deemed inadequate to allow determination of any current goshawk population trends in Assessment Area 1. The information collected to date is primarily from timber sale surveys and small-scale monitoring efforts over short periods of time which do not allow for determination of population declines or stability.

Table 18. Representative subset of published and unpublished goshawk studies conducted in the

Intermountain Assessment Area. Multiple papers or reports have resulted from the same study.

Source	Type	Topic(s)	Title [State]
Dewey 1996	report	movement, home range, juvenile dispersal, survival,	Ashley National Forest Goshawk Inventory and Monitoring Report, 1991-1996. [Utah]
Fischer 1986	dissertation	habitat	Daily activity patterns and habitat use of coexisting Accipiter hawks in Utah.
Hennessy 1978	thesis	habitat, human influences	Ecological relationships of accipiters in northern Utah, with special emphasis on effects of human disturbance.
Herron <i>et al.</i> 1981	report	counts, distribution	Population surveys, species distribution, key habitats of selected nongame species.[NV]
Hoffman <i>et al.</i> 1992	report	counts, population trends	Patterns and recent trends in counts of migrant hawks in western North America.
Jewell and Smith 1998	report	counts	Fall 1997 raptor migration study in the Goshute Mountains of northeastern Nevada.
Johansson <i>et al.</i> 1994	published paper	habitat characteristics	Goshawk habitat modeling, Dixie National Forest using vegetation and elevation data.[Utah]
Kaltenecker <i>et al.</i> 1995	report	counts	Monitoring of fall raptor migration in SW ID.
Lee 1981	published paper	human influences	Habituation to human disturbance in nesting accipiters. [Utah]
Shipman <i>et al.</i> 1997	report	dispersal, demography, habitat, home range size, reproduction, post-fledging behavior	Ecology of northern goshawks (<i>Accipiter gentilis</i>) in the shrubsteppe habitat of northeastern Nevada: a six-year summary.
Smith and Hoffman 1997	report	counts, population trends	Population trends of northern goshawks assessed from migratory counts in the western United States
White 1994	published paper	population trends	Population trends and current status of selected western raptors.
White <i>et al.</i> 1965	published paper	range and distribution	Goshawk nesting in the upper Sonoran in CO & UT.
Whitfield <i>et al.</i> 1995	report	counts	Inventory and monitoring of bald eagles and other raptors of the Snake River, Idaho.
Whitfield and Maj 1998	report	counts	Inventory and monitoring of bald eagles and other raptorial birds of the Snake River, Idaho: 1996-97 progress report.
Younk and Bechard 1994	published paper	habitat, feeding ecology, reproduction	Breeding ecology of northern goshawks high-elevation aspen forests of northern Nevada.
Younk 1996	thesis	demography, habitat, home range, feeding ecology, human influences, reproduction, density	Breeding ecology of the northern goshawk in relation to surface gold mining in naturally fragmented aspen forests of northern Nevada.

Figure 7. Numbers of Northern Goshawk Territories Reported In Assessment Area 4



Goshawk numbers indicated on this map represent the total number of goshawk territories reported by Federal agencies for their entire administrative area. Therefore, the numbers indicate generalized locations and do not indicate the actual locations of goshawk territories. Numbers reported by the States on private and other lands that were not reported by Federal agencies, may occur anywhere within the Assessment Area. These are represented by a circled italic number located near the center of the Assessment Area.



Table 19. Number of northern goshawk territories reported in Assessment Area 4, by reporting unit.

Reporting Unit	Number of Territories Reported
Bureau of Land Management	
Malad Field Office	1
Owhyee Field Office	1
Snake River Field Office	1
Vernal Field Office	2
National Park Service	
Bryce Canyon National Park	5
Grand Teton National Park	34
Great Basin National Park	2
US Forest Service	
Ashley	51
Caribou	28
Dixie	53
Fishlake	12
Humbolt-Toiyabe	194
Manti-La Sal	43
Payette	53
Salmon-Challis	31
Targhee	52
Uinta	11
Wasatch-Cache	28
Total Reporting Units	602

Examination of the number of territories first reported as occupied, by year, reveals an interesting trend both for the Assessment Area and for the entire petitioned area. These data indicate that in 1992, the year of Forest Service Region 4’s decision to adopt and implement the Management Guidelines for the southwest (Reynolds *et al.* 1992), and the year following the Region’s determination of the goshawk as a sensitive species, there was a spike in the number of newly discovered territories. This observation is consistent with the spike in number of territories first reported in 1992 in the entire Petitioned area. Unfortunately, there is no data available regarding level of effort expended to find goshawk territories across years, or possible random effects of weather. These population data may be confounded by these factors.

Conclusions

Although historical goshawk population data are not available, it is reasonable to conclude that there may have been local goshawk population declines within the Intermountain Region when compared to pre-settlement times. This conclusion is not unique to northern goshawks, but is common when inferring wildlife population changes since pre-settlement times. This conclusion of likely local declines is based primarily on inferred effects of logging and local catastrophic changes in habitat due to factors including fire and insect outbreaks, as detailed above for various forest types of the Intermountain Assessment Area. Northern goshawk pairs appear widespread throughout forest types in the Assessment Area, and there is no evidence of extirpation.

Assessment Area 5

Status of goshawk populations in the Pacific Southwest Assessment Area (Area 5)

Introduction

Assessment of goshawk populations in the Pacific Southwest Assessment Area, made up of the State of California, was made based on review of available literature and ongoing studies, and analysis of goshawk data provided by land managers and the State of California. A number of studies and inventories of goshawks have been or currently are being conducted within this Assessment Area. Table 20 displays a summary of these studies by author, topic and location.

Table 20. Selected goshawk studies conducted within the Pacific Southwest Assessment Area, by author, publication type, location, and topic.

Author (s)	type*	location	topic
Hargis <i>et al.</i> 1994	MS,P	Sierra Nev.	Home range and habitat selection: telemetry
Austin, K.K. 1993	MS	Cascades	Home range and habitat selection: telemetry
Saunders, L. B. 1982	MS	Cascades	Nest area habitat
Allison, B. 1996	MS	Cascades	Nest area, landscape level habitat, density, GIS
Rissler, L.J. 1995	MS	Cascades	Nest area habitat structure
Keane, Morrison 1994	PhD,P	Sierra Nev.	Habitat selection, preybase relationships, telemetry
Keane, J. 1997	PhD	Sierra Nev.	Ecological relationships, prey, home range: telemetry
Hall, P.A. 1984	MS	Klamath	Nest area habitat
McCoy, R. 1998	MS	Cascades	Prey selection, energetics
Woodbridge, Detrich 1994	P	Cascades	Occupancy patterns, nest area habitat fragmentation
Detrich, Woodbridge 1994	P	Cascades	Fidelity to mate & nest site; breeding, natal dispersal
Schnell, J.H. 1957	P	Sierra Nev.	Prey selection
Farber <i>et al.</i> 1998	R	Statewide	Nest area, PFA habitat, managed forestlands
DeStefano <i>et al.</i> 1994	P	Cascades	Demographics, population parameters
Bloom, Stewart 1986	R	Statewide	Status, distribution, historical records, gen. ecology

*type: MS=Master’s Thesis, PhD=Doctoral Dissertation, P=journal publication, R=unpublished report

All of these studies provide valuable information on the ecological relationships of goshawks in various forest types in California; however, few address population parameters such as density, or annual reproductive performance, and none evaluate population trends. Seven of the studies were conducted within a single study area (Goosenest/ McCloud RDs).

Distribution and Reported Numbers:

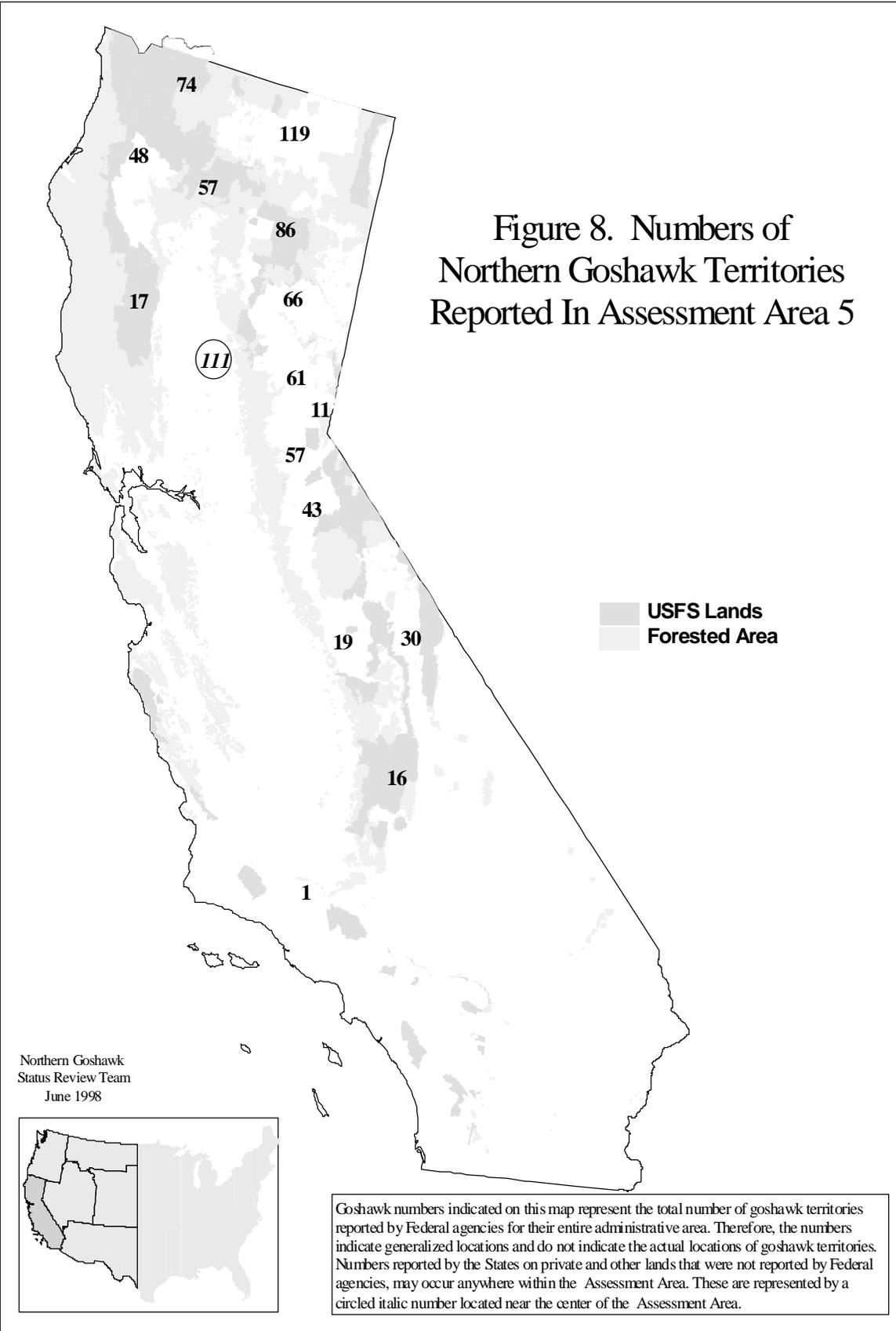
Systematic surveys for goshawks have not been conducted at a large scale within the Pacific Southwest Region, and the majority of territories reported were discovered during timber sale surveys, spotted owl surveys, or other activities. In recent years, intensive surveys for spotted owls (all provinces), and marbled murrelets (N. Coast and west Klamath provinces) have resulted in searches of large areas of potentially suitable goshawk habitat by wildlife biologists; and subsequent discovery of many goshawk territories. In northern California, only 11 territories have been reported in the Coast Ranges, and of these, 4 were located in drier Douglas-fir habitats inland from the true coastal forest. Because large areas do not receive systematic goshawk surveys, numbers of territories reported here should be considered minimums: on the other hand, some territories reported as active may have been abandoned over time. Nonetheless, the distribution and overall number of territories provide the best currently available estimates of the general distribution and relative abundance of goshawks within the various Provinces (table 21). A total of 816 goshawk territories were reported within the Pacific Southwest Assessment Area (Figure 8).

Goshawk territory data reported for the Sierra Nevada and Cascade ranges, and the Modoc Plateau, suggest that the species is well-distributed throughout these Provinces. Despite high variability in survey effort, densities reported by National Forests and National Parks are remarkably similar, generally from one territory per 5,000 to 7,000 acres of forested habitat (table 21). Only the Sierra National Forest reported relatively low densities; it is unknown whether this density results from low survey effort or scarcity of goshawk territories. More intensive survey and monitoring efforts on nine National Forest Ranger Districts distributed throughout these Provinces provide adequate data to at least roughly estimate territory density (table 22).

Land managers in the Klamath Province reported intermediate numbers of territories, and suggested that extremely steep terrain often tends to limit survey effort there. In the mesic western portion (Douglas-fir/ Hardwood Zone) of the Klamath Province (Six Rivers and western Klamath National Forests), intensive goshawk surveys in large tracts of late-successional forest detected very few territories, suggesting that the species is relatively scarce there. Numbers of territories reported were much higher in the drier eastern portion of the province.

Very few territories were reported for the North Coast Range, where in recent years, intensive surveys for northern spotted owls and marbled murrelets would be expected to detect additional territories. Since 1992, only two active territories have been reported in the North Coast Range Province, one on private timberlands and the other in late-successional redwood in a State Park. In addition, recent (1995) implementation of intensive stand-level surveys for marbled murrelets in coastal forests have not resulted in detection of additional goshawk territories. Suitability of coastal habitat may account for the lack of goshawks in this area. Coastal forests are typically characterized by dense undergrowth and high understory stem density. Density of forbs, shrubs, and regenerating trees are extremely high in early to mid-successional habitats where sunlight reaches the ground, and in many late-successional stands exhibiting treefall gaps.

Figure 8. Numbers of Northern Goshawk Territories Reported In Assessment Area 5



Late-successional stands frequently exhibit dense, multilayered canopies and subcanopies (Franklin and Dyrness 1973). Open understory conditions are typically associated with the stem exclusion stage when high canopy closure suppresses understory growth (Franklin and Dyrness 1973). It is likely that foraging goshawks, which tend to hunt in the ground-shrub and shrub-canopy zones of the forest (Reynolds and Meslow 1984) are limited by dense vegetation structure, which may conceal prey from detection and capture. Several authors have suggested that in coastal forests of the Pacific Northwest, the abundance of goshawk territories is strongly limited by the low proportion of landscapes occupied by forest stands with open understory conditions preferred by foraging goshawks (Reynolds and Wight 1978, Marshall 1992, DeStefano and McCloskey 1997). Goshawks also appear to be rare and of limited distribution in the Southern California/Central Coast Range Provinces. Despite intensive surveys and demographic study of California spotted owls in mature forests throughout this province, no active goshawk territories have been detected in over a decade. Nesting has been observed in Ventura County (Mt. Abel and Mt. Pinos) in 1904, 1989 and 1990; and a set of eggs was collected in San Diego County (Cuyamaca Mts.) in 1937 (Kiff and Paulson 1997). These reports and scattered observations of adult goshawks (including defensive behavior and juvenile birds) suggest that the species is present at very low densities (Lentz 1993). It is unknown whether goshawks nesting in southern California are colonists from a larger metapopulation in the Sierra Nevada, or if a small self-sustaining population persists in the scattered "islands" of higher-elevation conifer habitat.

Historical Trends

Based on assessment of historical habitat changes in many areas of the Pacific Southwest Assessment Area, it is reasonable to conclude that goshawk populations may have been reduced from historical levels, but the magnitude of population change is unknown. Extensive areas of lower elevation mixed conifer and ponderosa pine forest of the Sierra Nevada and Cascade Ranges, and the Modoc Plateau were logged early in this century and do not currently support mature conifer forest in significant amounts. In some of these areas, goshawk territories are centered on remaining fragments of mature forest, and landscapes lacking such fragments are not occupied (Allison 1996). Despite widespread changes in the amount and distribution of mature forest habitat throughout the Sierra Nevada and Cascade ranges and Modoc Plateau, however, goshawk territories remain well-distributed and (in areas with intensive inventories) at densities comparable to studies elsewhere in North America (Table 22). Mature forest cover remains abundant and well-distributed in the Klamath Province, where goshawk populations likely resemble historical levels. In the North Coast Ranges Province, reduction of the amount of late-successional forest, increased vegetation density in managed forests, and short harvest rotation schedules in managed forests have likely resulted in reduction of local goshawk populations. However, several authors have suggested that under natural conditions, high vegetation density in mesic coastal forests provides poor quality habitat for goshawks, and that the species may naturally be rare in coastal habitats (Reynolds and Wight 1978, DeStefano and McCloskey 1997). There is a lack of recent nesting records in southern California, where intensive inventories for California spotted owls would be expected to detect nesting goshawks in areas where historical nesting areas were reported.

Table 21. Numbers and density of goshawk territories reported by agencies and private landowners for Assessment Area 5.

Reporting Unit	# Terrs. Reported	Reported Density
Sierra Nevada/ Cascade Province		
Eldorado NF	57	1/ 5,329 ac. (4.64/ 100km ²)
Inyo NF	30	1/ 3,307 ac. (7.47/ 100km ²)
Klamath NF (eastside)*	35	1/ 2,123 ac. (12/ 100km ²)
Lassen NF	86	1/ 5,975 ac. (4.13/ 100km ²)
Modoc NF (Warner Mts)	60	
Plumas NF	66	1/ 4,875 ac. (5.07/ 100km ²)
Sequoia NF	16	1/ 5,993 ac. (4.21/ 100km ²)
Shasta-Trinity NF (eastside)*	31	1/ 2,241 ac. (11/ 100km ²)
Sierra NF	11	1/ 30,133 ac. (0.82/ 100km ²)
Stanislaus NF	43	1/ 6,183 ac. (4.64/ 100km ²)
Tahoe NF	39	1/ 7,182 ac. (3.44/ 100km ²)
Lake Tahoe Basin	11	1/ 6,820 ac. (3.04/ 100km ²)
State Parks	2	unk.
Yosemite NP	22	1/ 5,818 ac. (4.25/ 100km ²)
Private Timberlands	49	unk.
Modoc Plateau Province		
Modoc NF (excl. Warner Mts)	59	1/ XXX ac. (X.XX/ 100km ²)
Private / State Timberlands	5	unk.
California Klamath Province		
Six Rivers NF	48	1/ 10,138 ac. (2.44/ 100km ²)
Mendocino NF	17	1/ 14,782 ac. (1.67/ 100km ²)
Shasta-Trinity NF (west-side)	26	1/ 25,553 ac.(0.97/ 100km ²)
Klamath NF (west-side)	39	1/ 11,789 ac.(0.48/ 100km ²)
Private / State Timberlands	9	unk.
North Coast Range Province		
Private / State Timberlands	7	unk.
National Parks	0	
Southern California Province		
Los Padres NF	2	unk.
Angeles, Cleveland, San Bern. NF	0	

Density = # territories reported per area of "suitable" habitat. *= intensive survey area

Current Status

Available population data are inadequate to allow determination of any current trends in goshawk populations in the Pacific Southwest Assessment Area. Territory data provided to the Status Review represent an accumulation of territory locations over time, and only small subsets of these territories have been monitored adequately to assess long-term occupancy.

Population studies on the Klamath National Forest; Gooseneck Ranger District (Woodbridge and Detrich 1994, Detrich and Woodbridge 1995), and other monitoring efforts on National Forest lands (Lassen National Forest, Modoc National Forest), suggest that, while annual occupancy and reproductive success are highly variable, most known territories continue to be used by goshawks over a period of many years. Many of these territories exhibiting long-term occupancy are in areas with long histories of extensive timber harvest. In addition, occupancy and habitat data for 68 territories on privately-owned industrial forestlands in California demonstrate that goshawks also persist in intensively-managed forest landscapes (Farber *et al.* 1998). Reports from Forest Service biologists often correlated local timber harvests with abandonment of known goshawk territories; however the level of survey typically was adequate only to assess occupancy of a specific nest grove, not the entire territory. Landscape-level surveys are necessary to assess whether territory abandonment has in fact occurred. This information does not allow determination of population declines or stability, and indicates that our understanding of the relationship between goshawks and amounts of mature forest habitat is inadequate to infer goshawk population trends from current habitat trends.

Conclusions

Goshawks are well-distributed and relatively abundant in most forested areas in California. Goshawks appear to be of limited distribution and rare in the North Coast and Southern California Provinces. Some reduction in historical goshawk populations likely resulted from large-scale changes in amounts of mature forest habitat occurring from roughly 1850-1950. Goshawk population data and habitat trend data available for the Status Review are not adequate to allow determination of current (post-1988) trends in goshawk populations in California.

Reported densities of territories were much higher in eight units (in this case Forest Service Ranger Districts) where relatively high levels of survey effort were expended by Forest Service biologists (Table 22).

Table 22. Densities of goshawk territories reported for Forest Service units with intensive goshawk inventory programs.

Reporting Unit	#territories total	#territories post-1990	% territories post-1990	Reported density*
Sierra Nevada/Cascades				
Lassen NF, Almanor RD	42	40	95%	1/ (2.5/100km ²)
Lassen NF, Eagle Lake RD	28	23	82%	1/ acres
Modoc NF, Warner Mt. RD	60			1/ acres
Klamath NF, Gooseneck RD	35	34	97%	1/ 2,123 ac.
Shasta-Trinity NF, McCloud	31	24	77%	1/ 2,241ac.
Eldorado NF, Placerville RD	29	22	76%	1/ acres
Plumas NF, Beckwourth RD	25	22	88%	1/ acres
Modoc Plateau				
Devil's Garden/Big Valley RDs	55			
Other N. American studies			Study Area(ha)	
Kennedy 1989 (New Mexico)	7	7		6.36/ 100km ²
Reynolds and Joy 1998	107	107	173,200 ha.	6.17/ 100km ²
Woodbridge and Detrich 1994	11	11	10,230 ha	10.7/ 100km ²
Woodbridge and Detrich 1994	6	6	10,440 ha.	5.75/ 100km ²
DeStefano <i>et al.</i> 1994	9	9	10,519 ha.	8.6/ 100km ²
DeStefano <i>et al.</i> 1994	3	3	11,396 ha.	2.6/ 100km ²

* crude density: number of recently active territories per area of forested habitat.

Assessment Area 6

Status of goshawk populations in the Pacific Northwest Assessment Area

Introduction

Assessment Area 6 includes the states of Oregon and Washington. Assessment of goshawk populations in the Pacific Northwest Assessment Area was made using the same approach as other assessment areas including review of available literature, agency and nonagency reports, analysis of goshawk data and information provided during the public comment periods, and personal communications. A significant number of studies and surveys have occurred in both Washington and Oregon dating from the 1970s with most conducted since 1990 (Schommer and Silovsky 1994, Hayes and Desimone *in review* 1998, Table 23). Additional studies or surveys continue on both public and private lands including the Olympic Peninsula (Finn *et al.* 1998; Jim Michaels, pers. comm. 1998).

Table 23. Published and unpublished goshawk field studies, summary and progress reports for Washington and Oregon.

Author(s)	Type	Location	Topic(s)
Washington			
Fleming 1987	Report	western Wash., Olympics	status, habitat
Buchanan & Irwin 1993	Publication	eastern Wash.	nest sites
Schommer & Silovsky 1994	Report	Oregon, Washington	status, monitoring, management, research
Bosakowski & Vaughn 1996	Publication	western Wash. Cascades	survey methods
McGrath 1997	MS (Thesis)	eastern Or. & Wash.	nesting habitat
Smith <i>et al.</i> 1997	Publication	statewide	distribution, status
Watson <i>et al.</i> 1998	Publication, in Review	statewide	survey methods, nest success
Wagenknecht <i>et al.</i> 1998	Report	eastern Wash.	breeding ecology
Finn <i>et al.</i> 1998	Report	western Wash.	habitat, productivity, demographics

Oregon			
Hayes & Desimone 1998	Report, in review	statewide	status, ecology
Reynolds 1975	MS.	Or. Coast, Cascades. Eastern OR.	distribution, density, productivity
Reynolds 1978	Ph.D.	Or. Coast, Cascades. Eastern OR.	food and habitat partitioning
Reynolds & Wight, 1978	Publication	Or. Coast, Cascades. Eastern OR.	distribution, density, productivity
Anderson 1980	Report	northeast Oregon	nesting habitat
Reynolds <i>et al.</i> 1982	Publication	northeast Oregon	nesting habitat
Reynolds & Meslow 1984	Publication	Coast range, southcentral Or.	food habits and competition
Moore & Henny 1983	Publication	Northeast Or.	nest site characteristics
Henny <i>et al.</i> 1985	Publication	Northeast Or.	breeding chronology, molt, measurements
Marshall 1992	Report	Or, Wash	status, distribution, ecology
Schommer & Silovsky 1994	Report	Or, Wash	status, monitoring, management, research
Bull & Hohmann 1994	Publication	northeast Or.	breeding biology
DeStefano <i>et al.</i> 1994	Publication	eastern Or.	density, productivity
Haines 1995	MS	northeast Or.	breeding habitat
Rissler 1995	MS	southern Cascades Or. and Calif.	habitat structure,
Daw 1996	MS	eastern Or.	nest site, habitat
Desimone 1997	MS	southcentral Or.	nesting habitat, occupancy
Thraikill & Andrews 1997	Publication	Coast Range	nesting habitat
McGrath 1997	MS	eastern Or. & Wash.	nesting habitat
DeStefano & McCloskey 1997	Publication	Coast Range	habitat, distribution, foraging

Distribution and Reported Numbers

Northern goshawk territories have been documented throughout Assessment Area 6 in most forested regions except the north Coast Range of Oregon and juniper woodlands of southeast Oregon (Reynolds and Wight 1978, Marshall 1992, Destefano and McCloskey 1997, Hayes and Desimone *in review* 1998). Goshawk densities appear to increase as you move from the Coast Ranges of Washington and Oregon into eastern portions of both states (DeStefano and

McCloskey 1997, Watson *et al.* 1998). Goshawk territories have been located through a combination of random and systematic surveys within more intensive study areas (e.g., Reynolds 1975, Haines 1995, Desimone 1997, Wagenknecht *et al.* 1998), timber sale surveys (Schommer and Silovsky 1994), or general field surveys for other species such as northern spotted owls (Buchanan and Irwin 1993). At least 267 territories were reported to the Service for its Status Review in Washington and 484 in Oregon (Figure 9), primarily on Federal lands (Table 24). These numbers should be viewed with caution as not all Federal land management units responded to the data request, also some reported territories may no longer exist due to past forest management activities (e.g., regeneration harvest), extensive fires or insect epidemics subsequent to their discovery. Although some studies or surveys in Table 23 include private forest company lands, limited data are available from private and tribal lands. These ownerships constitute about 54% of commercial forest lands in Washington and 38% in Oregon and are distributed throughout the Assessment Area. Active territories are known to exist on some nonfederal lands and surveys are being conducted by some ownerships (Jim Michaels and Rick Gearhart, pers. comm. 1998).

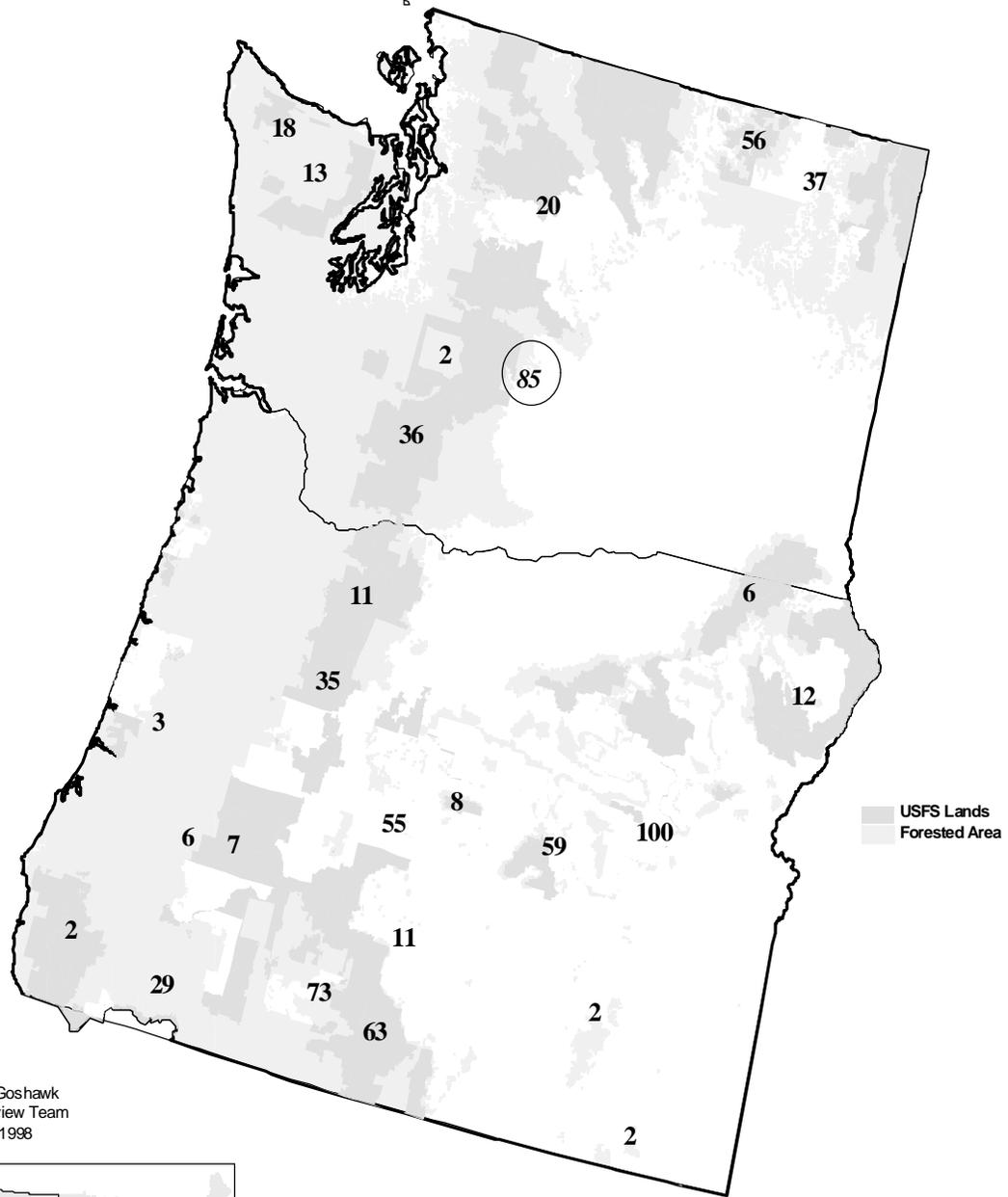
The distribution and abundance of northern goshawks in the Coast Range mountains of Washington and Oregon are the least known of the entire assessment area. Only four territories are reported to date for the entire coastal physiographic province south of the Olympic Peninsula, two in each state (DeStefano and McCloskey 1997, Hays and Desimone *in review* 1998, Watson *et al. in review* 1990). Factors likely responsible for the low numbers of goshawks in these coastal forests include the following:

- 1) The species is more numerous than reported, but survey effort insufficient: There has been little systematic effort to survey coastal habitats in the PNW for breeding goshawks. In Oregon, surveys by Reynolds (1975, 1978) and DeStefano and McCloskey (1997) were small in scale and detected no goshawks. However, there have been intensive, large-scale surveys for northern spotted owls on both public and private lands, in habitats expected to support goshawks, for nearly a decade. These surveys have resulted in detection of very low numbers of goshawks in coastal forests (Thrailkill and Andrews 1996, DeStefano and McCloskey 1997). However, identical surveys in the western Cascades, Inner Coast Ranges, and Klamath Mountains have resulted in discovery of numerous goshawk territories, suggesting that the differences in reported numbers of goshawk territories are at least reflective of actual differences. In addition, recent (1995) implementation of intensive stand-level surveys for marbled murrelets in coastal forests have not resulted in detection of additional goshawk territories.
- 2) Natural low suitability of temperate rainforest as goshawk habitat: Coastal forests in the Pacific Northwest are typically characterized by dense undergrowth and high understory stem density. Density of forbs, shrubs, and regenerating trees are extremely high in early to mid-successional habitats where sunlight reaches the ground, and in many late-successional stands exhibiting treefall gaps. Late-successional stands frequently exhibit dense, multilayered canopies and subcanopies (Franklin and Dyrness 1973). Open understory conditions are typically associated with the stem exclusion stage when high canopy closure suppresses understory growth (Franklin and Dyrness 1973). It is likely that foraging goshawks, which tend to hunt in the ground-shrub and shrub-canopy zones of the forest (Reynolds and Meslow 1984) are limited by dense vegetation structure,

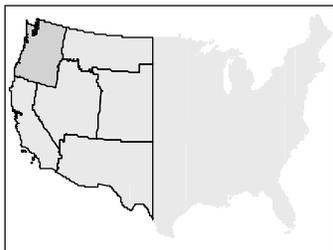
which may conceal prey from detection and capture. Several authors have suggested that in coastal forests of the Pacific Northwest, the abundance of goshawk territories is strongly limited by the low proportion of landscapes occupied by forest stands with open understory conditions preferred by foraging goshawks (Reynolds and Wight 1978, Marshall 1992, DeStefano and McCloskey 1997).

- 3) **Habitat destruction:** Coastal forests in the Pacific Northwest have a long history of timber harvest, due at least in part to gentle terrain and ease of access to coastal ports and cities. Currently, a high proportion of coastal forests in Oregon and Washington are private industrial timberlands or State lands, where production of wood products is emphasized. Little late-successional habitat remains in these areas. Of the 1.4 million acres of late-successional redwood forest estimated to exist historically, less than 6% remained in 1992 (USDI 1992). Similarly, lowland forests in southwestern WA and the Puget Sound have been extensively logged and little late-successional forest remains (USDI 1992). In the Coast Ranges of Oregon, approximately 64% of the forested landbase is private industrial timberland. Timber harvest has been extensive on all ownerships in the OR Coast Range, and less than 15% of the landbase is in mid-late-successional condition (USDI 1992). A high proportion of timber harvests within coastal forests are clearcut and shelterwood prescriptions, which remove forest structure required for nesting by goshawks. In addition, removal or reduction of forest canopy permits increased sunlight to reach the ground, stimulating shrub growth and resulting in development of dense vegetation structure (Franklin and Dyrness 1973). Such conditions likely result in loss of foraging habitat for goshawks, which may require more open understory conditions for detection and capture of prey (Reynolds and Meslow 1984).

Figure 9. Numbers of Northern Goshawk Territories Reported In Assessment Area 6



Northern Goshawk
Status Review Team
June 1998



Goshawk numbers indicated on this map represent the total number of goshawk territories reported by Federal agencies for their entire administrative area. Therefore, the numbers indicate generalized locations and do not indicate the actual locations of goshawk territories. Numbers reported by the States on private and other lands that were not reported by Federal agencies, may occur anywhere within the Assessment Area. These are represented by a circled italic number located near the center of the Assessment Area.

Conclusions

Goshawk populations appear fairly widely distributed throughout the Pacific Northwest assessment area based on the studies and surveys reviewed above. Population densities appear to be naturally lower in portions of western Washington and Oregon, however, survey effort has been limited, particularly in the Coast Range province. Recent discoveries of nesting goshawks in younger forests of western Oregon (Thraillkill and Andrews 1997; Mike Blow, pers. comm. 1998) confound the issue. The higher numbers of nesting territories located on the Olympic Peninsula is a unique situation which requires further study.

Based on studies in the Pacific Northwest identified above and elsewhere, it is likely that populations have decreased in some areas, particularly western Washington and Oregon, from pre-settlement periods given the extensive timber harvest that has occurred on both public and private lands and land conversion to non-forest uses throughout both states. Desimone (1997) documented an apparent decline in historical territories due to timber management activities in southcentral Oregon although the short-term nature of the study unfortunately limits the value of the results.

Table 24. Goshawk territories reported by land management agencies and state natural heritage programs in Assessment Area 6.

State	Landowner or Data Source	No. Territories
Washington	Washington Dept. of Fish and Wildlife, Wildlife Information System	84
	Okanogan National Forest	56
	Colville National Forest	37
	Gifford Pinchot National Forest	36
	Mt. Baker-Snoqualmie National Forest	20
	Olympic National Forest	18
	Olympic National Park	13
	Mount Rainier National Park	2
	Bureau of Land Management: Spokane District Office	1
Subtotal:		267

Oregon	Malheur National Forest	100
	Winema National Forest	73
	Fremont National Forest	63
	Ochoco National Forest	59
	Deschutes National Forest	55
	Willamette National Forest	35
	Bureau of Land Management: Medford District Office	29
	Bureau of Land Management: Lakeview District Office	11
	Mt. Hood National Forest	11
	Wallowa-Whitman National Forest	12
	Bureau of Land Management: Prineville District Office	9
	Umpqua National Forest	7
	Bureau of Land Management: Roseburg District Office	6
	Umatilla National Forest	6
	Bureau of Land Management: Eugene District Office	3
	Siskiyou National Forest	2
	Bureau of Land Management: Burns District Office	2
	Hart Mt. National Antelope Refuge	1
	Sheldon National Wildlife Refuge	1
	Subtotal:	484
	TOTAL:	751

Conclusion for All Assessment Areas

Territory numbers reported for the Status Review are used with caution because they are based on agency databases which include historical sites that may no longer exist (e.g., burned, logged, no recent occupancy), may not be complete and up-to-date, may include locations that have not been verified and may include duplicate records due to reporting from different sources. For some of these reasons, the Status Review did not analyze the complete set of reported territories (3,242 sites). Instead, the analysis looked at a subset of territories (2,729 sites) for which many of the problems listed above could be addressed.

While the Service approached the territory data reported for the Status Review with caution, it is important to note that approximately 75 percent of the territories reported were first located in the past 10 years. This large percentage is reflective of the increase in survey effort that Federal agencies implemented in the 1990s, and is consistent with the Service's expectation that as survey efforts improve, more goshawk territories will be documented throughout the western United

States.

Distribution

Examination of goshawk distribution as reported in the Review Area shows that the northern goshawk is well distributed in the forested west, and that its current distribution does not appear to be greatly different from its historical distribution.

Status and Trend

Population trends among areas and over time are poorly known (Squires and Reynolds 1997), and migration or Christmas bird counts are difficult to interpret because of low numbers observed, biases inherent in the methodology, and irruptive migrations (Titus and Fuller 1990). Kennedy (1997) found no evidence of a decline in goshawks in North America based on its range, demographics (density, fecundity, and survival) and population trends, and suggested that a more detailed meta-analysis is needed to address this question. Based on a variety of evidence for northern goshawk across North America, Kennedy concludes that there is no strong evidence to indicate that goshawk populations are declining, increasing or stable. She emphasizes two possible conclusions based on her analysis: 1) either the goshawk is not declining or 2) current sampling techniques are insufficient to detect population trends. Based on the available information, the Service finds no evidence that the population of northern goshawks in the contiguous United States west of the 100th meridian is declining at this time.

While the Service approached the territory data reported for the Status Review with caution, it is important to note that approximately 75% of the territories reported were first documented in the past 10 years. This large percentage is reflective of the increase and improvement in survey effort that Federal agencies have implemented in the 1990s. The Service is confident that as survey efforts continue to improve, more goshawk territories will be documented throughout the western United States.

Points Raised by the Petitioners

The petitioners made numerous statements purporting a decline in the goshawk population rangewide and throughout the petition area, leading to the assertion that the goshawk in the western United States is threatened with extinction. As discussed above, the claim that the goshawk population is declining is not documented. Specific points raised by the petitioners regarding goshawks in the western United States are addressed below.

The petitioners state that the goshawk has suffered a decline throughout the western United States. However, there is no scientific evidence documenting a decline in the goshawk population. Some of the evidence cited by the petitioners has been refuted by studies conducted after the date of the petition, some of the statements were based on erroneous interpretations of published and unpublished literature, and some of the statements were completely unsupported.

The petitioners cite Bloom *et al.* (1985) as stating that the goshawk population in California had decreased by 1/3 as of 1985, and that the species was once common in southern California but is rarely seen now. Regarding the reported decrease in the California goshawk population, the Service notes that there were no baseline studies conducted prior to the 1981-1983 surveys Bloom references, and the methodology used to estimate the decline was not described. This estimate appears to be based on speculation, and the Service questions whether it represents

documentation of a true decline. Bloom stated that migrant goshawks were once common in southern California in the nonbreeding season; he was not referring to breeding populations. However, as discussed above, migrant counts are not a reliable method of assessing goshawk population trend. The migrant individuals observed in southern California may have coincided with irruption years. Telemetry studies in California strongly suggest that the species is resident (at least in the Sierra and Cascades).

The petitioners cite Crocker-Bedford (1990) and Crocker-Bedford and Chaney (1988) as evidence that populations on the Kaibab Plateau in northern Arizona have declined substantially. They cite Crocker-Bedford (1987) as estimating a historical population of 260 pairs on the North Kaibab Ranger District (NKR D) that had declined to 130 pairs by 1972, and to 65 pairs in 1985. The petitioners cite Zinn and Tibbitts (1990) as estimating only 27 pairs on the NKR D in 1990; the petitioners further state that only 43 territories remained in 1996.

The historical population of 260 goshawk pairs estimated by Crocker-Bedford (1990) would result in a density nearly three times the density of 3.26 pairs per 10,000 acres reported by Reynolds and Joy (1998) from the NKR D. Reynolds and Joy's reported density, in turn, is the highest ever reported for the species. Thus, the historical estimate by Crocker-Bedford is unrealistic. Further, his methodology in calculating that density has been criticized (P. Detrich, U.S. Fish and Wildlife Service pers. comm. 1998, see Kennedy 1997).

Crocker Bedford's (1990) study was conducted over the period of 1985-1987, whereas Reynolds and Joy's study is the most intensive ever done on North American goshawks and is both more recent and longer in duration (1991-1997, and ongoing) than Crocker-Bedford's. Reynolds and Joy report 95 territories on the NKR D, which is over twice as many as the petitioners' estimate of 43 pairs and more than triple Zinn and Tibbitts' (1990) estimate. Given that Reynolds and Joy's calculated density is the highest reported for the species, it is likely that the current number of pairs on the NKR D approximates the numbers that occurred historically.

The petitioners also state that low occupancy rates on the NKR D further indicate a declining population. For example, they state that only 23 of 43 territories on the NKR D were occupied in 1996. However, Reynolds and Joy (1998) report that most, if not all, of the 95 known territories appear to be occupied every year. The petitioners further cite Crocker-Bedford's (1990) estimate of an 80% reduction in occupancy on the NKR D. Again, Reynolds and Joy's long-term intensive study shows territories at or near full occupancy every year on the Kaibab Plateau, although not all pairs breed every year.

The petitioners point to low productivity as further evidence that the goshawk on the Kaibab Plateau is at risk. For example, they again cite Crocker-Bedford's (1990) contention that productivity has dropped 94% on the NKR D. However, Reynolds and Joy have shown that productivity is relatively constant among years, ranging from 1.2 to 2.0 young per nest per year. Fecundity, however, was variable given that the proportion of pairs laying eggs ranged from 22 to 87%. Reynolds and Joy (1998) attribute this variability in fecundity to annual variations in prey abundance. While this variation may be somewhat influenced by timber harvests or other management, it is likely that this variation is also a natural phenomenon in the southwest. For example, pairs on the Grand Canyon National Park portion of the Kaibab Plateau, which is not subject to timber harvest, have shown similar variation in fecundity.

The petitioners make other unsupported statements. For example, they state that intensive conservation measures are needed or the goshawk will drop below its minimum viable population. This statement is included in a 1986 letter by Crocker-Bedford to the District Ranger on the NKRD. This is Crocker-Bedford's opinion based on his observations at the time and is pertinent only for this portion of the petitioned area. A minimum viable population was not known for northern goshawks at that time and is not known for goshawks today (Maguire and Call 1993). More importantly, today, 12 years later, the North Kaibab Ranger District still has a breeding population of northern goshawks, and the number of known pairs is about 10 times the number known to occur on the District in 1986.

The petitioners cite the State of Arizona's ban on take for falconry as another piece of evidence that the population is precariously low (see discussion of falconry under Factors C and D in the "Summary of Factors Affecting the Species" section of this finding). While it is true that in 1991 the Arizona Game and Fish Commission placed a moratorium on falconry take of goshawks, this moratorium was established because at that time it became apparent that known goshawk nests were relatively few in number and largely restricted to the NKRD in northern Arizona. Greatly increased goshawk survey efforts between 1991 and 1995 revealed a much larger breeding population fairly well distributed across Arizona's montane conifer forests. In the early 1990s two demography studies were initiated in Arizona, but results regarding the stability of these populations will not be available for several years. In 1996, with many more breeding pairs known to occur in the state but population performance unknown, the moratorium was lifted, with a quota of three birds per year.

Similarly, the petitioners point to the State of New Mexico's continuing ban on falconry. They cite Williams' (1997) analysis that led to a continuing moratorium on goshawk take for falconry. Williams found a "considerable" decline in occupancy and a "drastic" decline in productivity for the years 1994-1996 based on Forest Service occupancy data. However, as stated elsewhere in this document, the Service questions the reliability of using Forest Service occupancy data, which the Service also obtained for its goshawk Status Review. These data were often compiled based on opportunistic discoveries of goshawk nests while Forest Service staff were conducting other activities and were not based on sufficient levels of surveying and monitoring efforts directed specifically at goshawks over a long period of time (>5 years). Such survey effort should concentrate on identifying all potential alternate nests a pair may have within a territory, and not infer non-occupancy until the possibility of occupancy at an alternate nest within the territory has been ruled out. Williams' analysis did not take into account the bias in inferring non-occupancy, particularly when a comprehensive goshawk surveying and monitoring program was not in place. Variation in fecundity appears to be a normal phenomenon in the southwest, and results based on a 3-year period are inconclusive given that fecundity can vary with annual changes in prey population cycles and other factors. Furthermore, demographic studies (Wooten and Bell 1992, Noon and Biles 1993) generally point to adult survivorship, and not productivity, as the key parameter determining population viability.

In summary, the petitioners rely heavily on Crocker-Bedford's and others' assertions that goshawks on the NKRD and elsewhere on the Kaibab Plateau have declined precipitously, including an allegation that reductions in productivity and occupancy have combined to produce a 96% decline. However, Reynolds and Joy's 8 years of the most intensive study ever conducted on the species in North America has shown that known territories continue to be occupied.

The petitioners contend that the goshawk has declined elsewhere in the Southwest. For example, they cite Kennedy (1988) as stating that the population in northern New Mexico is a remnant of a larger population, and that the remaining birds continue to be threatened. However, Kennedy later retracted her statement (pers. comm. 1998, letter to D.A. Boyce 1993). The petitioners further attempt to bolster their claim by erroneously citing Kennedy (1988) as making the unsubstantiated claim that “25% of nesting females in New Mexico” are unmated.

Finally, the petitioners claim that the goshawk is imperiled in the Southwest, stating that only 83 pairs were known in the area in 1991 (and that there were actually probably less than 80), and that the single remaining nest on the Coconino National Forest would likely be lost to timber harvest. However, there are at least 108 pairs on the Kaibab Plateau alone, and responses to the Service’s data request showed a minimum total of 502 territories reported for and well distributed across Assessment Area 3. Of these, 317 were known to be occupied at least once in the 1990s, and only 33 were surveyed with an intense enough effort to be able to reasonably infer non-occupancy. The Coconino National Forest reported a total of 57 territories, at least 52 of which were occupied at least once in the 1990s.

The petition claims that the goshawk is declining elsewhere in the forested western United States, and “all peer-recognized goshawk experts have acknowledged that the population decline and continuing loss of...habitat are both very serious...”. Although many goshawk biologists have hypothesized that goshawks may be declining, the Service is unaware of any evidence confirming any declines. For example, the petition relies on Patla (1990, 1991) as evidence of a declining population. The unpublished reports by Patla suggest that goshawks had declined on one National Forest in Idaho, but do not provide substantial evidence or a statistically valid analysis of how this determination was made. Patla suggests that occupancy rates were lower at territories where timber harvest had occurred, but admits that “time was not available this year to search for other possible alternate nests at most unoccupied sites.” Reynolds and Joy (1998) point out the critical importance of intensive survey and monitoring efforts before lack of occupancy at a given territory can be determined. In addition, Patla’s sample size was very small (7 of the 11 total site checks during 3 years at post-harvest sites were conducted at only 3 sites), precluding any reliable conclusions regarding goshawk response to the harvests.

The petitioners cite Reynolds and Wight (1978) and Reynolds and Meslow (1984) for evidence of population declines in Oregon. However, neither of those papers reported evidence of declines (Reynolds, pers. comm. 1998). In an effort to determine the numbers of goshawks throughout the west, the petitioners requested information from the Forest Service and BLM, and cite the results of that effort as further evidence of low goshawk numbers. Based on the response to their request, they were only able to document 239 active and/or occupied territories in 1996. As discussed above, the Service believes that the number of occupied territories in the western United States is much higher. Based on information received in response to the Service’s data request, 709 goshawk territories were reported to be active at least one year in 1996 and 1997.

Summary of Factors Affecting the Species

Section 3 of the Act defines “endangered species” as one that is in danger of extinction throughout all or a significant portion of its range. A “threatened species” is defined as one that is likely to become an endangered species within the foreseeable future throughout all or a

significant portion of its range (16 U.S.C. 1532).

Section 4 of the Endangered Species Act (16 U.S.C. 1533) and regulations (50 CFR Part 424) promulgated to implement the Act set forth the criteria and procedures for adding species to the Federal lists. A species may be listed due to any one or a combination of the five factors listed in section 4(a)(1) of the Act, provided that known threats, either singly or cumulatively, are such that the species would meet the Act's definition of threatened or endangered.

The five factors and their application to the northern goshawk in the contiguous United States west of the 100th meridian are discussed below. Each factor is discussed in terms of the Service's findings during the status review process, as well as an evaluation of the points raised by the petitioners in either the petition or any of the subsequent information provided by the petitioners.

A. The Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range.

Introduction

The petitioned area covers some 920 million acres, of which 222 million acres (24%) are covered by forest vegetation that could be considered potential goshawk habitat (see Figure 2). This map served as a consistent baseline for the Status Review habitat evaluation. This forested habitat in the review area occurs in a variety of landownerships, and is managed for an array of management objectives.

The Service agrees that general population biology theories indicate there should be a relationship between change in forest habitat and a change in goshawk population. However, there is no documentation in research that demonstrates the nature of this presumed relationship across the entire petitioned area. Some studies reported local areas where a correlation between habitat abundance and goshawk populations was found (Desimone 1997; Crocker-Bedford 1990). These localized studies lend support to this general assumption, despite the lack of documentation for the petitioned area as a whole.

Because of the lack of documentation of a relationship between habitat and goshawk populations for the petitioned area, and because the species is known to use a variety of forest types and to be dependent on prey availability, caution is required in drawing conclusions about changes in forest habitat and goshawk population change. While caution is appropriate, it should not be concluded that forest habitat change is irrelevant to the goshawk population situation.

The Service's Status Review contains a more detailed analysis of potential goshawk habitat trends upon which this section is based.

Habitat Management

The petitioned area consists of a broad ecological range of forest conditions, from Pacific Northwest coastal forests to pinyon-juniper woodlands of Arizona. Correspondingly, there is a diversity of land management issues that have the potential to influence the condition of forested habitat. Throughout the petitioned area, timber harvest has affected, and will continue to affect, goshawk habitat. In areas where regeneration harvest practices occur, the effect is removal of nesting habitat resulting in loss of nesting habitat for at least several decades. In areas of selective

tree removal, the result is a more subtle effect on stand conditions, with varying effect on goshawk use of the area. In drier forest types, issues such as ‘forest health,’ the effects of decades of wildfire suppression, and urban-forest interface conflicts are actively being discussed (Everett and Baumgartner, 1995) and have important implications for goshawk habitat.

Based on current data, the Service estimates that Federal lands constitute approximately 80% of the forested lands in the petitioned area. Federal land managers in the petitioned area include 84 National Forests, 137 BLM offices, and 78 National Parks. Among the Federal lands with potential goshawk habitat, the National Parks and Monuments are expected to be managed in a manner that will continue to provide goshawk habitat because of their legal charter and management emphasis (acknowledging that some loss of habitat will occur from natural events such as fire, windthrow and regrowth to conditions unsuitable to goshawks). Forest Service and BLM lands are expected to be managed for multiple-use purposes, including timber harvest, which would remove goshawk habitat to varying extents.

Non-Federal lands in the petitioned area are managed for a variety of objectives. For the purposes of this analysis, it is assumed that these lands, including industrial forestlands, Tribal lands and state forestlands, would continue to be managed as they have in the past decade.

Sources of Habitat Information

Several sources of information about goshawk habitat status and trends were pursued: information was requested directly from land managers; the scientific literature and habitat analyses were reviewed; and timber harvest data were gathered from the Forest Service.

Because of problems identified in the Service’s Status Review, habitat data collected from land managers could not be used in the habitat analysis. Large-scale science and planning documents including the Northwest Forest Plan, Interior Columbia Basin Ecosystem Assessment, Southwest Regional Goshawk Guidelines, Mexican Spotted Owl Recovery Plan, and the Sierra Nevada Ecosystem Project, serve as additional sources of information about goshawk habitat condition and trends.

The third source of goshawk habitat trend data was Forest Service silviculture reports which provided acres of land harvested with various silvicultural prescriptions. For the petitioned area, the Team documented a decline in the acreage affected by timber harvest in the past 10 years (Figures 11 and 12). In large areas, these declines in timber harvest are the result of recent adoption of management strategies to manage and protect more acres of habitat, which reduces the acreage available for timber harvest. This change in harvest pattern has a general effect of slowing the loss of goshawk nest habitat and reducing the period of time before areas affected by harvest can provide goshawk habitat structure and function.

To understand the effect of declining harvest levels on goshawk habitat, it is necessary to look at the context in which the harvest occurs. Figure 13 displays the total National Forest System acreage in the Review Area and the portion of that acreage that is allocated as “Suitable for Timber” as of 1995. In comparison, the figure shows the acreage harvested between 1988 and 1997.

Figure 11

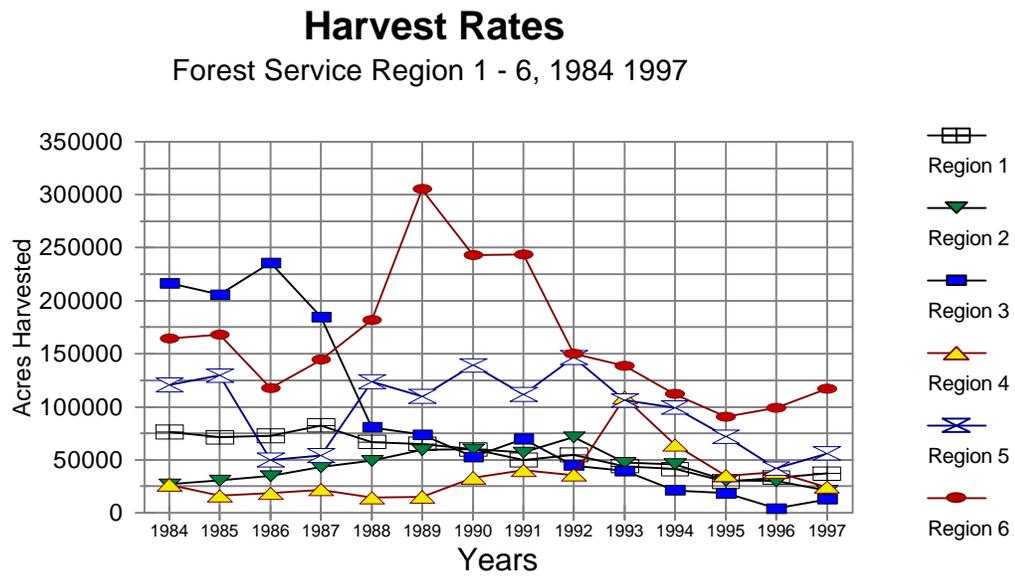


Figure 12

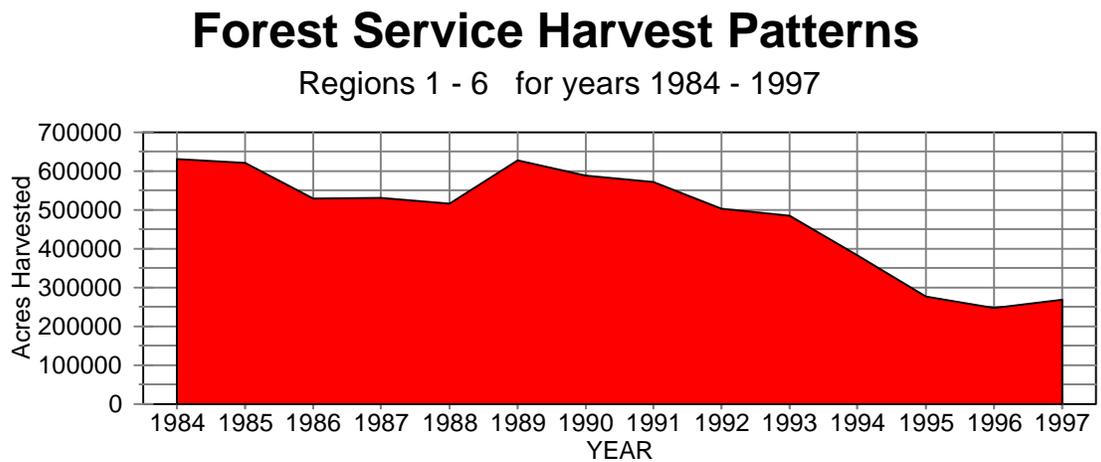
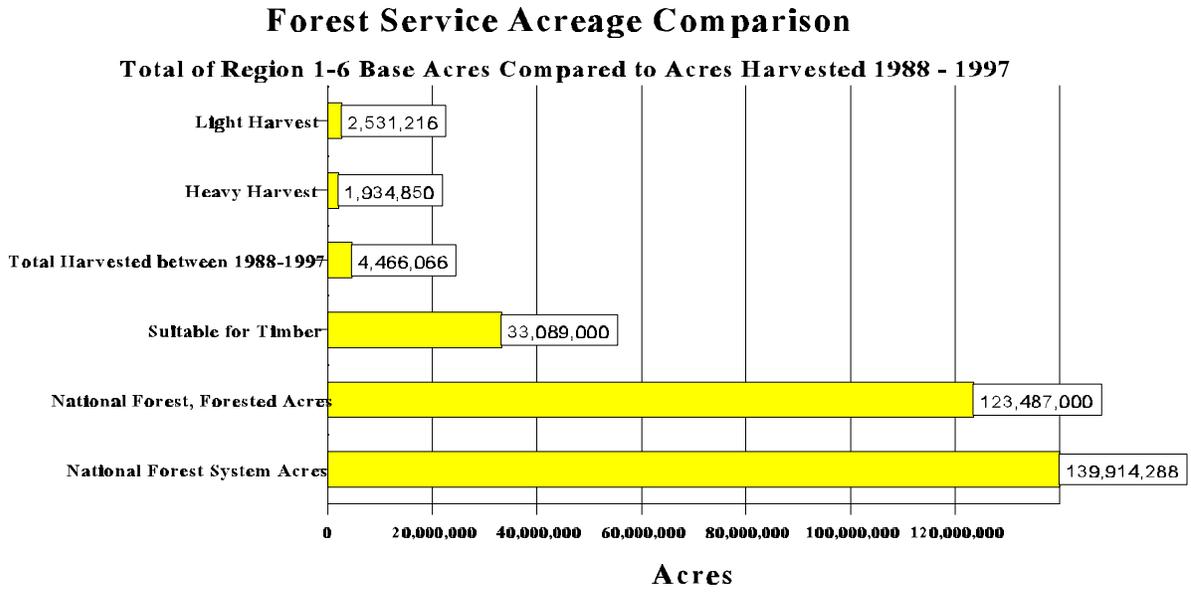


Figure 13



Assessment Area 1

Introduction and Current Habitat as Modeled from FIA data

Assessment Area 1 consists generally of the State of Montana, northern Idaho, and portions of North Dakota and South Dakota (see Figure 3). Table 25 provides an initial view of the potential forest vegetation, by ownership, in the Area.

Table 25. Forest Cover Types, by Land Manager/Owner - Assessment Area 1

Forest Type	Indian Lands	National Forests	Bureau of Land Management	National Park Service	Fish and Wildlife Service	Other Lands	Total
Douglas-fir	174,000	3,984,000	605,000	184,000	6,000	1,065,000	6,018,000
Elm-ash-cottonwood					1,000	61,000	62,000
Fir-spruce	9,000	1,237,000	37,000	12,000	2,000	81,000	1,378,000
Larch	27,000	1,216,000	3,000	84,000	1,000	521,000	1,852,000
Lodgepole pine	383,000	10,835,000	308,000	553,000	6,000	770,000	12,855,000
Ponderosa pine	665,000	4,635,000	338,000	168,000	2,000	2,582,000	8,390,000
Western hardwoods	2,000	26,000	1,000	4,000		9,000	42,000
Western white pine	91,000	1,168,000	15,000			674,000	1,948,000
Total	1,351,000	23,101,000	1,307,000	1,005,000	18,000	5,763,000	32,545,000

Habitat Trends

The Forest Service provided documentation of their conclusions regarding goshawk habitat management on the National Forests in Forest Service Region 1, which is within Assessment Area 1. The following interpretations are based upon that documentation:

The Forest Service concludes that goshawks use a variety of forest cover types in this Assessment Area and identified the following principle forest types used by goshawks: mixed conifer, Douglas-fir, lodgepole pine, ponderosa pine, aspen, and cedar-hemlock (Maj 1996). The Forest Service estimates these forest types total approximately 10 million acres in this Assessment Area. An unknown percentage of these forests were in seral stages suitable for goshawk use (i.e., mature and old-growth forests). Spruce-fir forests are considered to be important goshawk habitat in very few areas. Of the goshawk nest stands reported to the Status Review, 60% were

Forest Service Region 1 Harvest Patterns

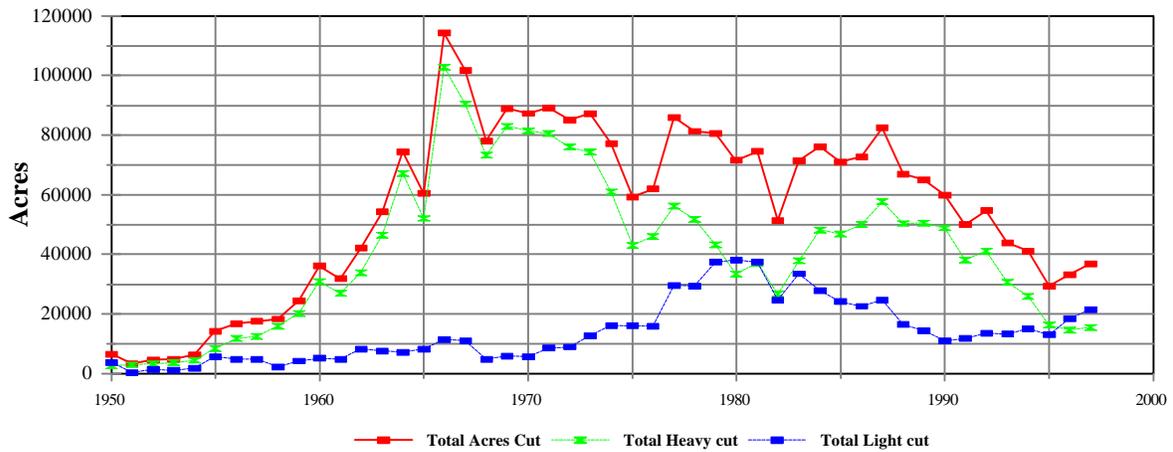


Figure 14. Forest Service Timber Harvest in Region 1, Derived From Annual Silviculture Reporting.

in Douglas-fir types, 16% in lodgepole, 14% in Ponderosa pine and 9% in other types. As previously cautioned, these proportions should not be compared against the percentages of these cover types because survey effort to identify nest sites was not randomly placed in the habitat, nor rigorous enough to determine absence of birds.

The Forest Service Regional Summary states that current abundance and distribution of suitable goshawk habitat differs from pre-settlement conditions (Maj 1996). Changes in the amount of some forest types and seral stages are attributed to a combination of wildfires, fire suppression, mining, grazing, urbanization, and timber harvest. These changes have resulted in a decrease in some goshawk habitat types and an increase in other habitat types. In particular, mature and old-growth seral stages in the ponderosa pine and cedar-hemlock forest types are less abundant than in pre-settlement conditions.

Timber harvest data for the last 45 years from the Forest Service in Region 1 (Figure 14) illustrates a harvest of 1,970,834 acres of forested habitat (8% of the National Forests; see Appendix A) which we assume was goshawk habitat, using silvicultural methods that caused long-term (greater than 100 years) loss of goshawk nesting habitat (See Appendix A for discussion of “heavy” and “light” harvest effects). In the same time period, another 600,000 acres (2% of the National Forests) were harvested with methods resulting in degradation, though not complete loss of goshawk nesting structure and cover. This total of 2,570,834 acres of forested habitat represents 11% of the National Forest acreage, and 30% of the land currently classified in the timber base (as of 1995).

Current land management plans on National Forests in Assessment Area 1 are expected to result in both increases and decreases in the amount of seral stages suitable for goshawk habitat (Maj 1996). Table 26 provides information on how individual National Forests are managing for mature and old-growth forests and what the Forests’ expectations are with respect to future goshawk habitat.

Table 26. Summary of Forest Service Judgements of Future Expectation of Mature and Old-Growth Forests and Goshawk Habitat on National Forests in Assessment Area 1. Derived from USDA Forest Service, M. Maj, 1996.

National Forest	Targets for Retention of Old-Growth in Forest Plans		Statements Regarding Future Changes to Goshawk Habitat
	As % of Landscape	As % of Timber Base	
Helena NF	5%		Increase
Deerlodge NF		5%	Stable
Beaverhead NF		10%	?
Gallatin NF		30%	?
Lewis and Clark NF		5%	Decrease
Custer NF		Not Specified	?
Lolo NF	8%		?
Bitterroot NF		No Provision	?
Kootenai NF		Not Specified	?
Flathead NF		Not Specified	?
Nez Perce NF	10%	5%	Stable
Clearwater NF	10%	5%	Decrease
Idaho Panhandle NF		No Provision	?

The Columbia Basin Science Assessment includes Ecological Reporting Units (ERUs) that cover the westernmost quarter of Assessment Area 1. As reported by Quigley *et al.* (1997), the goshawk viability panel did not foresee any situation where the current range of the species would not be maintained. The assessment by Quigley *et al.* (1997) also projected goshawk habitat under the Alternatives being considered in the EIS, most of which were rated as creating an improved situation by reducing the likelihood of isolated populations and areas of local extirpation.

Another analysis being prepared by the Columbia Basin Science Team is documentation of “source habitats” throughout the Basin (Wisdom *et al.* in prep). For the Basin as a whole and for each Ecological Reporting Unit, they report the historic (circa 1850) and current (circa 1990) percentage of the landscape which was/is “source habitat” for summer and winter. The definition of “source habitat” is acreage with characteristics of macro vegetation (trees and shrubs) that contribute to stable or positive population change. The habitat is measured with square pixels of 1 kilometer in size. Their analysis includes the absolute percentage of change of source habitat from historic to the present situation. It also presents the relative change; that is, “Of the XX% of the landscape in source habitat in 1850, what percentage now occurs?” Finally, they present a rating of the trend in change of this habitat.

For the ERUs entirely or partially in Assessment Area 1, they conclude that all ERUs show a decline in goshawk summer habitat (Table 27). For goshawk winter habitat, all but one have

declined. The declines in overall habitat in this analysis stem principally from the combination of large fires that occurred in the early 1900s and timber harvest on Federal lands and non-Federal lands. Hann *et al.* (1997) also discuss the loss and poor regeneration of white pine as a result of white pine blister rust.

These conclusions about source habitat require further explanation. The loss of goshawk summer source habitat would tend to indicate the species should be rare in the area. Yet recent goshawk surveys continue to find new territories, and greater than 51% of the reported sites were documented as active in the last 7 years. In discussions with Status review Team members, the report authors suggested that the fire patterns in these areas, often mixed-severity fires which killed 20 to 70% of the overstory trees (Hann *et al.* 1997), created patches of unburned mature and old-growth forest which would likely be smaller than the pixel size of the source habitat analysis (1 kilometer square). While too small to be counted in the source habitat analysis, these patches, surrounded with burned mid-seral habitat (which was generally not salvage logged) create a mosaic of vegetation sufficient to support the existing goshawk population.

ERU	Summer - Historic Percentage	Summer - Current Percentage	Summer - Absolute change in Percentage	Summer - Relative change from historic to current	Winter - Historic Percentage	Winter - Current Percentage	Winter - Absolute change in Percentage	Winter - Relative change from historic to current
5	17.77	8.37	-9.41	-52.92	16.14	19.73	3.59	22.27
7	28.63	1.54	-27.09	-94.62	28.43	2.94	-25.50	-89.66
8	25.04	1.69	-23.35	-93.24	25.07	1.69	-23.38	-93.25
9	15.61	0.54	-15.07	-96.66	18.05	.87	-17.18	-95.19
13	15.46	14.39	-1.07	-6.92	17.75	14.08	-8.68	-20.63

Conclusions regarding goshawk habitat trends in Assessment Area 1

Information from the Forest Service, reported separately (Maj 1996), led the Forest Service to conclude that current levels of goshawk habitat are probably below historic levels for the cedar-hemlock and ponderosa pine habitat types, and they estimated that other habitats are probably similar to historic levels.

The Columbia Basin Science work reinforces the conclusion that goshawk habitat has declined. The ‘source habitat’ analysis presents a clearer picture of the magnitude and nature of the decline, but the large pixel size results in an underestimation of current habitat. In any case, the decline has not resulted in the species being rare in the assessment area.

Current timber harvest rates are substantially below those of a decade ago and reflect a trend away from traditional silvicultural prescriptions and toward prescriptions that have less disruptive effects and shorter-term effects on forest cover. Large-scale habitat changes will occur due to forest health and catastrophic events, and due to management actions designed to address these issues. However, changes in management of forests are likely reducing the degree of threats associated with habitat loss.

Assessment Area 2

Introduction and Current Habitat as Modeled from FIA data

Assessment Area 2 consists of the States of Colorado and Wyoming and the portions of South Dakota, Nebraska and Kansas that are in the Review Area (see Figure 4). Table 28 provides an initial view of the potential forest vegetation, by ownership, in the Area.

Habitat Trends

Based upon the total forested acreage figures of Table 28, the Forest Service manages 61% of the potential goshawk habitat in Assessment Area 2; BLM 16%; National Park Service 6%; and other landownerships 17%.

The Forest Service Rocky Mountain Regional Office provided a draft Biological Evaluation (BE) regarding management of habitat for goshawk. It included a brief summary of habitat management considerations and conclusions for four of the ten National Forest units in the Area. It also discussed some broad conclusions for the Region as a whole.

The Forest Service BE reports goshawks use a variety of forest cover types in this Assessment Area. Table 29 provides their estimates of acres of the mature and old-growth forest types they judge to be used by goshawks on Forest Service lands in Assessment Area 2. Friedlander (in litt. 1998) identified four forest types as being the primary habitat for goshawk; lodgepole pine, ponderosa pine, aspen, and Douglas-fir (mixed conifer).

Table 28. Forest Cover Types, by Land Manager/Owner - Assessment Area 2

Forest Type	Indian Lands	National Forests	Bureau of Land Management	National Park Service	Fish and Wildlife Service	Other Lands*	Total
Aspen-birch	2,000	1,077,000	181,000	7,000		129,000	1,396,000
Douglas-fir	18,000	592,000	239,000	180,000		248,000	1,277,000
Elm-ash-cottonwood		5,000				50,000	55,000
Fir-spruce	208,000	5,576,000	244,000	215,000		189,000	6,432,000
Lodgepole pine	136,000	3,990,000	539,000	1,047,000		395,000	6,107,000
Oak-hickory						3,000	3,000
Pinyon-juniper	342,000	2,311,000	2,594,000	137,000		1,338,000	6,722,000
Ponderosa pine	102,000	3,499,000	689,000	49,000	2,000	1,508,000	5,849,000
Western hardwoods	27,000	698,000	281,000	61,000		157,000	1,224,000
Total	835,000	17,748,000	4,767,000	1,696,000	2,000	4,017,000	29,065,000

Table 29. Historic Abundance of Forest Types used by the Goshawk - Assessment Area 2 (Derived from Forest Service Biological Evaluation)

Habitat	Acres (millions)	Abundance of Mature and Old-Growth Forests
Spruce-fir (sub-alpine forest)	4.2	Not Abundant
Douglas-fir*	1.3	
Ponderosa pine*	2.1	Not Abundant
Lodgepole pine*	2.8	
Aspen*	2.1	
Pinyon-juniper	0.3	
Gambel oak	0.3	
High elevation riparian	Not Available	
Cottonwood riparian	Not Available	

* Identified as primary goshawk habitat by the Forest Service

The BE reports that the current abundance and distribution of suitable goshawk habitat differs from pre-settlement conditions. It states that a combination of fire suppression, mining, grazing, urbanization, and timber harvest has resulted in changes in the amount of some forest types and seral stages. These changes have resulted in a decrease in goshawk habitat for ponderosa pine forests and an increase for lodgepole pine forests. Table 30 provides estimates of late-successional habitat (mature and old-growth) for the most abundant forest types.

The Forest Service BE concludes that recent planning efforts on National Forests in Assessment Area 2 are expected to result in a stable or increasing amount of seral stages suitable for goshawk habitat. Table 30 is a summary of the information in the BE on how these habitats are expected to change as a result of implementation of these plans.

Table 30. Current and Future Estimates of Mature and Old-Growth Forests - Assessment Area 2 (Derived from Forest Service BE)

Habitat	Mature and Old-Growth Age Class	Current Percentage of Forest Type in Mature and Old-Growth Seral Stages	Expected Future Changes to Abundance of Mature and Old-Growth Seral Stages
Spruce-fir v (sub-alpine forest)	>200 yrs	?%	Currently abundant, with a continued increase in amounts
Douglas-fir*	>180 yrs	?%	Currently abundant and expected to remain so
Ponderosa pine*	>160 yrs	11.0%	Currently little late-successional forest, but current management is expected to increase older forests
Lodgepole pine*	>140%	11.0%	Historically and currently rare, but expected to increase due to fire suppression
Aspen*	>100 yrs	11.0%	Unknown

* Identified as primary goshawk habitat by the Forest Service

Friedlander (in litt. 1998, p. 24) states that timber harvests are declining throughout Assessment Area 2, and data collected by the Status Review Team corroborates this statement (Figure 15).

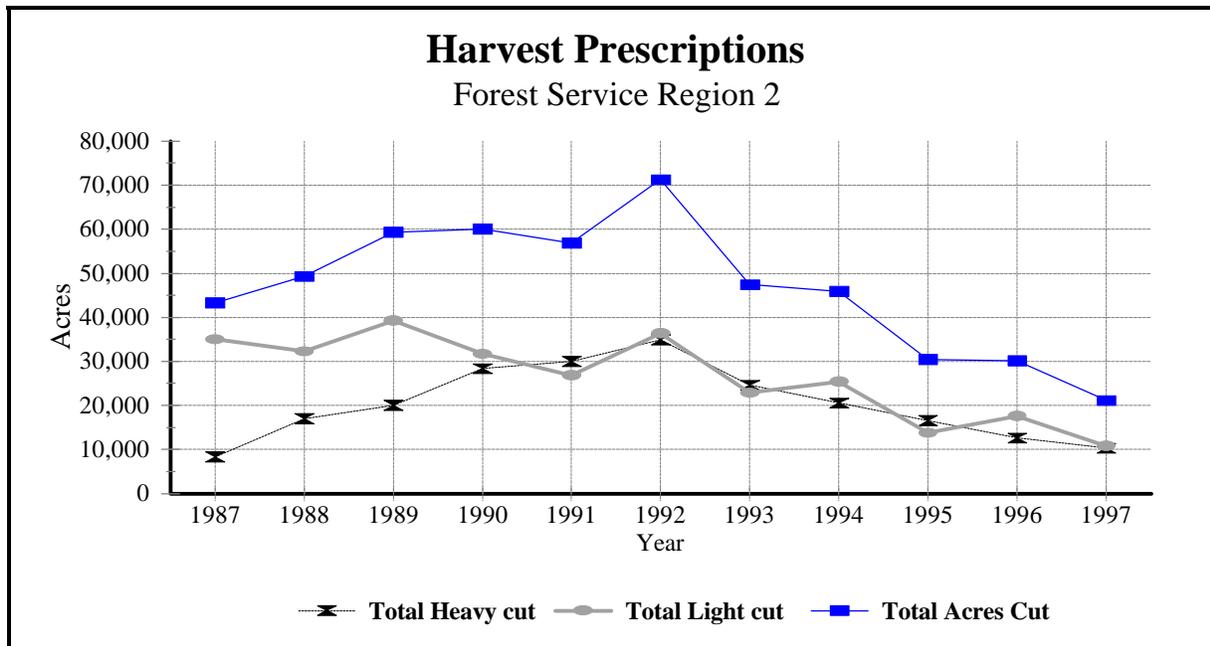


Figure 15. Total, Heavy and Light Harvest Acres in Forest Service Region 2, 1987 through 1997.

The Forest Service BE concludes that widespread fire suppression activities have significantly modified natural fire regimes, and continued exclusion of fire is expected to increase both the short-term value of forests to goshawks and the risks of large, catastrophic stand-replacing fires. They conclude that aggressive fuels reduction or forest-health treatments may reduce the risk of catastrophic events, but may (or may not) also decrease the value of forests to goshawks.

Conclusions regarding goshawk habitat trends in Assessment Area 2

The Forest Service concluded that, with the exception of the ponderosa pine forest type, Assessment Area 2 currently has an abundance of mature and old-growth forests available. The current amount of mature and old-growth forests is “probably at the high end of what was present prior to settlement.” Anticipated future management on National Forests is expected to increase the total amount of suitable seral stages.

Assessment Area 3

Introduction and Current Habitat as Modeled from FIA data

Assessment Area 3 consists of the States of Arizona and New Mexico, western Texas and the Oklahoma panhandle (Figure 6). Table 31 provides an initial view of the potential forest vegetation, by ownership, in this Assessment Area.

Habitat Trends

With the arrival of European settlers in the 1870s, southwestern forests were subjected to many new influences. Three primary factors played an important role in shaping current forest conditions: 1) disruption of natural disturbance regimes (i.e., aggressive fire suppression), 2) livestock grazing, and 3) commercial timber harvest (Cooper 1960; Covington and Moore 1992, 1994; Harrington and Sackett 1992).

Table 31. Forest Cover Types, by Land Manager/Owner - Assessment Area 3

Forest Type	Indian Lands	National Forests	Bureau of Land Management	National Park Service	Fish and Wildlife Service	Other Lands*	Total
Aspen-birch	7,000	61,000	5,000	1,000		119,000	193,000
Douglas-fir	33,000	302,000	4,000			140,000	479,000
Fir-spruce	93,000	385,000				166,000	644,000
Pinyon-juniper	4,192,000	7,711,000	3,524,000	737,000	74,000	5,347,000	21,585,000
Ponderosa pine	2,116,000	5,838,000	350,000	86,000	11,000	1,124,000	9,525,000
Western hardwoods	109,000	112,000	68,000	5,000	7,000	287,000	588,000
Total	6,550,000	14,409,000	3,951,000	829,000	92,000	7,183,000	33,014,000

Limited sources of data are available to quantify habitat trends in southwestern forests. Forest inventories conducted in New Mexico and Arizona in the 1960s (Choate 1966, Spencer 1966) and 1980s (Conner *et al.* 1990, Van Hooser *et al.* 1992) provide insight into changes over a period of approximately 25 years. However, differences in definitions and data collection methods make comparisons between the 1960s and 1980s data difficult and results must be interpreted with great caution. These differences include: 1) changes in definitions of vegetation types, 2) changes in the landbase being sampled (e.g., due to changes in wilderness designation), and 3) changes in sampling intensity.

The following comparisons are limited to commercial forest lands in Arizona and New Mexico. Total forested land increased by approximately 5% from the 1960s to the 1980s while the commercial forest landbase decreased by approximately 15% (Table 32). The proportion of several forest types also changed from the 1960s to the 1980s. Mixed-conifer forests increased, spruce-fir remained approximately the same, and the proportion of ponderosa pine and aspen forests declined (Table 33). Possible explanations for changes in proportions of forest types include: 1) invasion and succession of mixed-conifer species into other types (meadows, aspen) in the absence of fire; 2) selective harvest of ponderosa pine in mixed-conifer, and; 3) changes in forest type definitions.

Table 32. Changes in Total Forested Land and Commercial Forest Landbase from the 1960s to the 1980s in Arizona and New Mexico. *

	1960s (ac x 1000)	1980s (ac x 1000)	% Change
Total Forest Land	11,160	11,738	+5
Commercial Forest Land	10,246	8,701	-15

*Sources of Data: Choate (1966), Spencer (1966), Conner *et al.* (1990) and Van Hooser *et al.* (1992).

Table 33. Changes in Area and Distribution of Forest Types from the 1960s to the 1980s on Commercial Forest Lands in Arizona and New Mexico. *

Forest Type ¹	Area in 1960s (ac x 1000)	Proportion of 1960s Area	Area in 1980s (ac x 1000)	Proportion of 1980s Area	Change in Proportion
PP	7,992	78	6,252	72	-6
MC	1,173	12	1,752	20	+8
SF	635	6	496	6	0
QA	446	4	201	2	-2
TOTAL	10,246	100	8,701	100	

¹ Forest Type: PP- ponderosa Pine, MC- mixed conifer, SF- spruce-fir, QA- quaking aspen

*Adapted from USDI Fish and Wildlife Service (1995). Sources of data: Choate (1966), Spencer (1966), Conner *et al.* (1990) and Van Hooser *et al.* (1992).

Changes also occurred in size-class distribution of trees on commercial lands in Arizona and New Mexico from the 1960s to the 1980s (Table 34). Mid-sized trees (13-18.9 in diameter breast height (dbh)) increased in absolute density (7.5%) but the proportion of mid-sized trees did not change. Large trees (>19 in dbh) decreased from 2.2 to 1.7 trees per acre, a >20% decline in absolute density. This decrease is not surprising given the disproportionate harvest of large trees during this period.

Table 34. Changes in Density (trees per acre) and Distribution of Tree Size Classes from the 1960s to the 1980s on Commercial Forest Lands in Arizona and New Mexico.*

Tree Size Class (dbh in inches)	1960s Density (trees/ac)	1960s Proportion (% of total stems)	1980s Density (trees/ac)	1980s Proportion (% of total stems)	Change in Proportion	Density Change
1- 4.9	59.2	62.5	54.3	53.7	-8.8	-8.3
5-12.9	28.5	30.0	39.9	39.4	+9.4	+40.2
13-18.9	4.9	5.2	5.3	5.2	0	+7.5
> 19	2.2	2.3	1.7	1.7	-0.6	-20.4

*Adapted from USDI Fish and Wildlife Service (1995). Sources of data: Choate (1966), Spencer (1966), Conner *et al.* (1990) and Van Hooser *et al.* (1992).

In summary, from the 1960s to the 1980s, 1) total forested acres increased, 2) mixed-conifer apparently covered more of the landbase, while ponderosa pine and aspen covered less (but note cautions above regarding this conclusion), and 3) densities of large trees declined.

In the 1980s and into the early 1990s, high harvest levels of the larger size classes occurred on National Forest lands. Harvest rates for the Southwestern Region were available from 1984 to 1997 (P. Jackson, USDA Forest Service Region 3, Albuquerque, pers. comm. 1998). These showed a peak in total acres harvested in 1986 followed by a reduction beginning in 1988 (see Appendix A). Total “heavy harvest,” which consists of prescriptions that removed large trees (i.e., seed, removal, and clear cuts), peaked in 1991 and has been declining since 1992 (see

Appendix A).

A recent Final Environmental Impact Statement amending Forest Plans for the Southwestern Region (FEIS) (USDA Forest Service 1995) described existing forest structure on National Forest lands (Table 35). The percentages reported in the FEIS indicate approximately 34% of the existing landscape is in mature and older trees, and that approximately 50% of the landscape will fall into these older age classes in the long-term (200 years).

Table 35. Existing and Predicted Long-term (200+ years) Forest Structure Under Current Management Direction on National Forest Lands in Arizona and New Mexico.*

Tree Age/Size Class (dbh in inches)	Existing Conditions (%)	Predicted Conditions (%)
Seedling (0-1)	3	8
Sapling (1-5)	4	9
Young (5-12)	36	16
Mid-aged (12-18)	23	17
Mature (18+)	30	25
Old ¹	4	25

¹ Meets Regional standard for old growth (dbh varies by site and forest type).

*Adapted from USDA Forest Service (1995).

In the recent past, large acreages of forested habitats have also been lost to catastrophic fires (USDA Forest Service 1995). From 1989 to 1994, approximately 251,100 forested acres on National Forests were impacted by fire. Approximately 30% of these acres suffered a complete canopy loss (Table 36).

Table 36. Large Fire Effects to Forested Habitats (1989-1994) and Predicted Decadal Impacts (1994-2005). Adapted from USDA Forest Service (1995).

Cover Type	Fire Effects		
	Acres (x 1000) Impacted (1989-1994)	Complete Canopy Loss (%)	% Predicted to Burn (1994-2005)
Ponderosa Pine	174.5	38	18
Mixed Conifer	55.2	16	6
Spruce Fir	21.4	4	12
TOTAL	251.1	30	15

Habitat Projections for National Forests in Assessment Area 3

The following discussions are limited to National Forest lands in Arizona and New Mexico and are based on quantitative and qualitative analyses provided in the FEIS for the Southwestern Region (USDA Forest Service 1995) (these documents constitute the best information of this type available to the Service for its Status Review). The purpose of these amendments was to

incorporate the *Mexican Spotted Owl Recovery Plan* (USDI Fish and Wildlife Service 1995) and the regional goshawk guidelines (Reynolds *et al.* 1992) into all regional forest plans.

Under the selected alternative, prescribed fire and thinning of small trees (< 9 in dbh) are promoted. These management tools can help reduce the risk of stand-replacing fires in many areas. The FEIS evaluated short-term habitat losses due to catastrophic fire. From 1994 to 2005, the Forest Service estimated approximately 15% of ponderosa pine, mixed-conifer and spruce-fir forests will burn (Table 36). However, not all of the predicted burn area will consist of stand-replacement events.

Implementation of management standards and guidelines for Mexican spotted owls and northern goshawks will affect forest structure, primarily on lands classified as suitable for timber harvest. According to the FEIS, over the short-term (10-15 years), managed events are not expected to have profound effects on forest structure. Over the long-term (200+ years), the FEIS predicted significant changes to forest structure based on implementation of the selected alternative, most notably the increase in old trees (see Table 35).

The FEIS stated, however, that it is unlikely that the projected forest structure (Table 35) could ever be attained across large areas at tree densities specified for owl and goshawk nest/roost site target conditions. While large, contiguous areas of old-growth forest conditions are not necessary for goshawk nesting, areas with old-growth and mature forest conditions must occur and be well distributed across the landscape. The FEIS stated that large fires and insect and disease effects are expected to intervene long before the target conditions are achieved. However, the FEIS concluded that if forests are managed for substantially lower densities of trees (relative to present densities), the projected size-class distribution could probably be sustained across the landscape over the long-term.

Conclusions regarding goshawk habitat trends in Assessment Area 3

The bulk of goshawk habitat in Assessment Area 3 occurs on Federal lands (primarily Forest Service) where reductions in timber harvest in recent years (Table 31) have occurred. Today, timber harvest rates are well below those of even a decade ago in the Southwest.

Recent amendments to forest plans are aimed at managing southwestern National Forest lands to maintain and enhance spotted owl and goshawk habitat. This is significant since these Federal lands comprise most of the goshawk habitat in the southwest. In addition to the protection of Mexican spotted owl and goshawk habitat, management attention has turned to restoration of the natural processes (fire) and vegetation structure (open stands of large trees with patches of more dense vegetation). These changes in management focus, driven by legal responsibilities for ecosystem management and species viability, indicate a future improvement in goshawk habitat conditions at a large landscape scale. Existing goshawk nesting habitat will be protected by the Forest Plan amendment decisions. These management guidelines, along with a greater understanding of southwestern forest ecosystem functions gained over the last decade should prevent a significant move back to forest management strategies of the 1980s (R. Fletcher, USDA Forest Service Region 3, Albuquerque, pers. comm. 1998). With the implementation of guideline monitoring and use of adaptive management to adjust the guidelines and their implementation, goshawk habitat in the Southwest should remain relatively stable into the foreseeable future.

Assessment Area 4

Introduction and Current Habitat as Modeled from FIA data

Assessment Area 4 consists generally of southern Idaho, Nevada, Utah, and western Wyoming. This Assessment Area includes 41,475,993 acres of varying forest type administered by the Forest Service in 19 National Forests, Bureau of Land Management, non-Federal entities, Bureau of Indian Affairs, National Park Service, and Fish and Wildlife Service (Forest Service 1998). Table 37 provides an initial view of the potential forest vegetation, by ownership, in this Assessment Area.

Habitat Trends

Although the goshawk may require specialized habitat conditions for nesting, it is a forest habitat generalist in terms of forest types it uses for its various life history requisites. The following information is taken from various sources including agency reports, and is intended to supplement the limited amount of data on forest type trend, status, and projection received by the Service through responses to its data request entitled "Goshawk Data Summary." No published data or agency reports are available from the Forest Service that provide this northern goshawk habitat information on a regional scale in the format requested (J. Amundson, USDA Forest Service, Region 4, pers. comm. 1998).

Table 37. Forest Cover Types, by Land Manager/Owner - Assessment Area 4

Forest Type	Indian Lands	National Forests	Bureau of Land Management	National Park Service	Fish and Wildlife Service	Other Lands	Total
Aspen-birch	76,000	1,088,000	247,000			201,000	1,612,000
Douglas-fir	48,000	5,496,000	445,000	158,000	7,000	318,000	6,472,000
Fir-spruce	46,000	2,622,000	89,000	95,000		21,000	2,873,000
Larch		1,000				1,000	2,000
Lodgepole pine	3,000	4,708,000	243,000	368,000	3,000	165,000	5,490,000
Pinyon-juniper	693,000	5,674,000	10,545,000	288,000	99,000	1,901,000	19,200,000
Ponderosa pine	18,000	3,406,000	272,000	34,000		488,000	4,218,000
Western hardwoods	175,000	1,642,000	247,000	24,000	1,000	1,021,000	3,110,000
Western white pine						1,000	1,000
Total	1,059,000	24,637,000	12,088,000	967,000	110,000	4,117,000	42,978,000

Southern Idaho

This portion of Idaho includes about 13,800,000 acres of forest lands. However, not all forest types are necessarily potential goshawk habitat in this area (e.g., pinyon-juniper, hardwoods [cottonwoods]). Primary forest types include Douglas-fir, ponderosa pine and lodgepole pine based on FIA stand data (Table 38).

Forest Type Group	Total (acres)
Douglas-fir	5,273,783
Lodgepole pine	3,025,451
Ponderosa pine	2,588,831
Pinyon-Juniper	1,734,371
Western hardwoods	666,420
Fir-spruce	508,525
Aspen-birch	13,096
Larch	1,977
Western white pine	741
Total	13,813,195

During the past 4 years, all Federal lands in the entire Columbia River Basin east of the Cascades have undergone intensive study and analysis as part of the Interior Columbia Basin Ecosystem Management Project (ICBEMP) (Quigley *et al.* 1997). An extensive assessment was made of all resources including forest lands. The assessments compared historical to current conditions and it was determined that: 1) ponderosa pine has decreased across the Basin with a significant decrease in single-story structure, and large trees have decreased within roaded and harvested areas; and 2) mid-seral forest structures have increased in dry and moist potential forest vegetation along with an increase in the density of smaller diameter shade-tolerant trees (e.g., white-fir).

The ICBEMP has resulted in the development of the Upper Columbia Basin Draft EIS for Forest Service and BLM lands in Idaho, northern Nevada and Utah, western Montana and a small portion of western Wyoming (USDA and USDI 1997). Selection of a preferred alternative is expected in 1999. The preferred alternative is predicted to provide a high likelihood of species persistence and viability over the next 100 years. An expert panel reviewing potential impacts of all alternatives rated the preferred alternative as having a significant likelihood of improving the viability of goshawk populations across the project area.

Nevada

The Forest Service resource bulletin, "Nevada Forest Resources," summarized the results of the first State-wide forest inventory for Nevada (Born *et al.* 1992) (Table 39). Information is included about the extent and condition of the forest resources and recent forest product outputs

as of 1989. The area of reserved and non-reserved timberland and woodland by ownership class is shown in Table 40. In the Rocky Mountain States, timber species include aspen and cottonwood hardwood species and all softwood species except pinyon and juniper.

Table 39. Total Area (millions of acres) by Land Class and Owner Group, Nevada, 1989 (Born *et al.* 1992)

Ownership	Non-Forest	Forest
National Forest	3.0	2.8
Other Public	47.3	6.2
Private	10.2	0.8
Total	60.5	9.8

Table 40. Area of Reserved and Non-Reserved Timberland and Woodland by Ownership Class in Nevada (based on Born *et al.* 1992)

Land Ownership	Timberland	Woodland
Bureau of Land Management	106,505	6,024,047
Indian Lands	5,436	37,066
National Forest	435,406	2,354,217
National Park	38,055	19,769
Other public (including State and County)	3,460	30,147
Private	168,529	544,383
Total	757,391	9,009,629

Born *et al.* (1992) reported that of Nevada’s 757,000 acres of timberland, about 65,000 acres are in reserved status, meaning that tree utilization is precluded by statute or administrative designation. This reserved acreage figure may under-represent wilderness, National Park Service (including Great Basin National Park) lands, and scattered, inaccessible stands.

Utah

The Forest Service resource bulletin, “Forest Resources of Northern Utah Ecoregions,” presented the condition and extent of forest resources of the Forest Service’s northern Utah ecoregion, with emphasis placed on species diversity, forest health, and land use issues (O’Brien 1996). This approach differed from traditional timber summaries. Similar information is not yet available for the Forest Service’s southern Utah ecoregion.

Western Wyoming

No supplementary information on habitat condition and trend was specifically available for this sub-area. Discussion of habitat condition in the western Wyoming portion of Assessment Area 4 is included primarily in the discussion below of the Forest Service's Region 4 assessment process for upland conditions.

Timber Harvest Data

Timber harvest data for the last 10 years from the Forest Service in Region 4 illustrates a harvest of 109,730 acres (0.3% of the National Forests) of forested habitat which is assumed to have been goshawk habitat, using silvicultural methods that caused long-term loss of goshawk nesting habitat (See Appendix A for discussion of "heavy" and "light" harvest effects). Generally these acres currently provide foraging habitat for goshawks. In the same time period, another 298,098 acres (1% of the National Forests) were harvested with methods resulting in degradation, though not complete loss of goshawk nesting structure and cover. This total of 407,828 acres represents approximately 1% of the total National Forest acreage (as of 1997). As elsewhere in the western Forest Service Regions, there is a recent pattern in Region 4 that shows reductions in acres subject to "heavy" cut and increased proportions of "light" cut acreage. (Figures 16 and 17).

Forest Type Trend, Current Status and Projection

Region 4 of the Forest Service compiled a draft report entitled "Properly Functioning Condition: Rapid Assessment Process" (USDA Forest Service 1997) based on adaptation of the original site-specific riparian assessment process (USDI BLM 1993) to larger scales and to upland vegetation. This report provides the most recent qualitative information on current forest functioning condition. The PFC assessment process is based on the assumption that if vegetative communities and their processes are similar today to those occurring historically, then conditions will approximate those under which species evolved. The method assesses whether areas are within proper functioning condition (PFC) with regard to forest structure, composition, disturbance regime, and patterns; if an area is not within PFC, the method estimates the degree of departure from PFC. A summary of the relative risk to PFC at the Intermountain Regional scale is shown in Table 43.

Harvest Prescriptions Forest Service Region 4

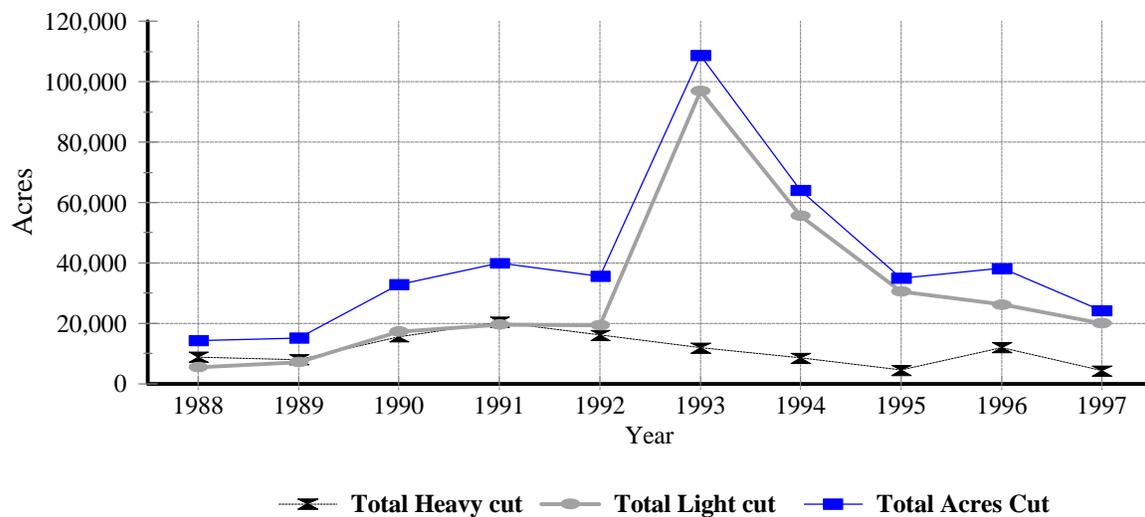


Figure 16. Total, Heavy and Light Harvest Acres in Forest Service Region 4, 1988 through 1997.

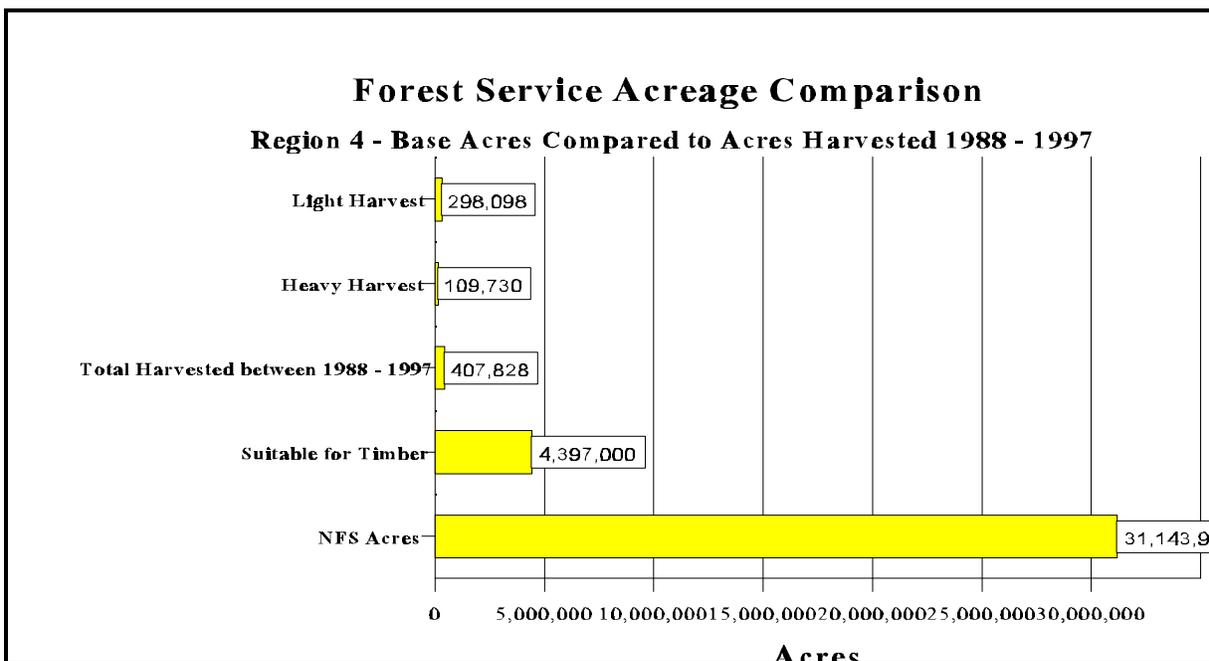


Figure 17. Comparison of Forest Service Harvest Acreage 1988 - 1997 Against Total and Suitable for Timber Acreage, Region 4.

Table 43. Regional Summary of Relative Risk of Departure from Properly Functioning Condition for All Reported Subject Areas (USDA Forest Service 1997)

Subject Area	High Risk	Moderate Risk	Low Risk
Riparian/Wetland	x		
Quaking Aspen	x		
Big Sagebrush/Grassland	x		
Pinyon-Juniper	x		
Tall Forb	x		
Engelmann Spruce-Subalpine Fir	x		
Grand Fir/White Fir complex	x		
Ponderosa Pine/Jeffrey Pine complex		x	
Ponderosa Pine (Southern Utah) type		x	
Douglas-Fir		x	
Lodgepole Pine		x	
Mountain Mahogany		x	
Subalpine Timberline Forests and Woodlands		x	
Mountain Brush complex			x
Gambel Oak			x
Alpine Lodgepole Pine			x

Areas used by northern goshawk that are at a high risk of departure from PFC include: quaking aspen, Engelmann spruce-subalpine fir, and grand fir/white fir complex. Those areas used by goshawks that are at a moderate risk of departure from PFC include: ponderosa pine/Jeffrey pine complex, ponderosa pine (southern Utah) type, Douglas-fir, lodgepole pine, and subalpine timberline forests and woodlands. The area used by goshawks that is identified at a low risk of departure from PFC is alpine lodgepole pine.

Catastrophic Loss of Habitat within Assessment Area

Factors contributing to catastrophic loss of forest vegetation within Assessment Area 4 include pine beetle infestation and fire. For example, in the Uinta Mountains of northeastern Utah, the pine beetle proliferated in great numbers in the 1980s, and there is a large landscape of dead overstory lodgepole pine on the east side of the Uintas now, with decaying trees and blowdown (K. Paulin, USDA Forest Service, Ashley National Forest, pers. comm. 1998). Assessment Area 4 includes several other areas that have been infested by pine beetle. Wildfire has played a major role in forest succession in parts of Region 4, including Utah (Bradley *et al.* 1992). Lodgepole pine, for example, owes much of its widespread occurrence to past fire. Decadent aspen stands are rejuvenated by periodic fire, and in this assessment area, aspen is an important cover type used by goshawks.

Conclusions regarding goshawk habitat trends in Assessment Area 4

The data available indicate that several vegetation types used by goshawks, with the exception of alpine lodgepole pine, in some areas within the Assessment Area are currently at moderate to high risk of departure from PFC (USDA Forest Service 1997). However, caution must be exercised in linking these conclusions directly to any trend in goshawk populations. While the goshawk typically does use mature forest or larger trees for nesting habitat, it appears to be a forest habitat generalist in terms of the variety and ages of forest types it will use to meet its life history requirements. Goshawks can use small patches of mature habitat to meet its nesting requirements within a mosaic of habitats in different age classes; a key factor appears to be availability of prey. Therefore, relative risk of departure from PFC cannot be reliably used as an indicator of trend in goshawk habitat.

Timber harvesting in the assessment area is declining, and an increasing proportion of the harvest is accomplished through silvicultural practices less damaging to potential goshawk habitat (see Appendix A). Therefore, goshawk habitat in the assessment area should improve over time.

The ICBEMP has resulted in the development of the Upper Columbia Basin Draft EIS for Forest Service and BLM lands in Idaho, northern Nevada and Utah, western Montana and a small portion of western Wyoming (USDA and USDI 1997) in this Assessment Area. Selection of a preferred alternative is expected in 1999. The preferred alternative is also predicted to provide a 63 percent likelihood of the goshawk having a functioning metapopulation in the area over the next 100 years. This would be an improvement over the current situation which was rated at 47 percent likelihood. Importantly, the rating of the historic situation is only 72 percent likelihood of a functioning metapopulation, which would be considered the best situation possible given the ecological conditions of disjunct habitat across the Columbia Basin.

Assessment Area 5

The Pacific Southwest Assessment Area includes the state of California (see Figure 8). Forest habitats within the state are managed by a variety of agencies, as well as large industrial timberland holdings. Among Federal land management agencies, the majority of forested lands are administered by the US Forest Service (17 National Forests: 56.5%), followed by BLM Districts (15%), and National Parks (4.2%). Private timberlands comprise 23.5% of California's forested area. It is important to recognize that ownership patterns vary widely among the different forest cover types. Over 83% of redwood forests, and 71% of western hardwoods are owned by industrial timber companies. Conversely, the Forest Service administers 83% of lodgepole pine and 75% of ponderosa pine forest area (California Dept. of Forestry 1988).

Habitat Trends

The Pacific Southwest Assessment Area supports approximately 34 million acres of forest habitat, of which about 19 million acres are considered productive timberlands (EPA data, California Dept. Forestry 1988). Natural variation in forest structure and composition among forest cover types, as well as the effects of forest management practices, affect the ability of these lands to provide habitat for northern goshawks. Timber harvest has had a variable effect on goshawk habitat, resulting in the reduction of older seral stages. Forest Service estimates show a 26% decrease in standing volume of large sawtimber (20+ inch dbh) from 1952 to 1992 (Powell *et al.* 1992), while smaller size classes have increased. The effects of timber harvest have been disproportionate in some forest types such as redwood, where less than 6% of historical late-

successional habitat remains (USDI 1992).

Forest ecosystems in California are diverse, ranging from temperate coastal rainforest to xeric eastside pine habitats (Table 44). Habitat suitability for goshawks, land management issues and habitat trends also vary widely among these physiographic regions and forest types. For the purposes of this assessment, habitat status and trends will be described separately for each major region, permitting a more detailed evaluation.

Table 44. Area (acres x 1000) of forest cover types, by data source

Forest Cover Type	RM-234*	FRRAP**	EPA ***
Douglas-fir	1,532 (1,179)	1,772	4,867
Ponderosa Pine	5,029 (4,246)	3,351	11,032
Fir-Spruce	5,875 (5,102)	2,134	2,907
Redwood/Sitka	1,162 (1,056)	1,570	1487
Lodgepole Pine	199 (199)	752	1,888
Mixed Conifer	N/A	10,652	N/A
Montane Riparian	N/A	86	N/A
Western Hardwoods	2,375	9,547	6,738
Pinyon-Juniper	0	1,463	4,900
California Total	13,797 (11,782)	18,544	33,819

Note: Acreage figures given in Powell *et al.* (1992) and Cal. Dept. Of Forestry (1988) are of “productive timberlands”, capable of growing more than 20 cubic feet of wood per year, and exclude forested areas that do not support sustainable timber yields. These figures are lower than EPA estimates that include total land base occupied by a given tree species group.

Sierra Nevada and Cascade Range Province

These interior mountain ranges constitute a band of similar forest types from the Oregon border into the southern 1/3 of California. The dominant forest cover types within this region include mixed conifer, true firs (red fir and white fir), yellow pines (ponderosa and Jeffrey), and, at lower elevations, oak woodland. Virtually all of California’s lodgepole pine and montane riparian forest are within this province.

Historically, forest conditions within the Sierran-Cascade Province were strongly influenced by climate, elevation, and wildfire. Forest conditions within the Sierran-Cascade Province have changed dramatically following Euro-American settlement. Logging, grazing, mining, introduction of exotic plant species, and fires caused large-scale disturbances to the natural communities, the effects of which continue today (Verner *et al.* 1992, USDA 1992). Removal of the mature overstory, in concert with suppression of natural wildfire, resulted in regeneration of dense stands, now 80+ years old and moving into a mature forest state. High tree density and accumulations of woody fuels in these stands have resulted in an increase in high-severity (stand-replacing) fires. The effects of logging and fire suppression have been less noticeable in higher-elevation true fir forests, where access for harvesting was limited until the 1950's. In general, the

proportion of the Sierran-Cascade Province occupied by dense mid-mature forest has likely increased over pre-settlement times; however the structure, composition and susceptibility of these stands to disturbance differs markedly from natural ranges (Franklin and Fites 1996, Verner *et al.* 1992).

Current Land Management Plans for National Forests within the Sierran-Cascade Province emphasize reduction of fire risk and other “forest health” issues as well as production of wood products. Under the 1995 California Spotted Owl Interim Standards and Guidelines (CASPO), harvest of mature forest habitat has been significantly curtailed. Management practices under CASPO include protection of 980 “Protected Activity Centers” (300 acres each) for spotted owls, totaling 294,000 acres. In addition, management guidelines which focus on improving or creating late-successional characteristics of forest stands have been incorporated into Land Management Plans for the Sierran National Forests. Data showing predicted trends in forested acres or suitable goshawk habitat on Federal Lands were not available for this Assessment.

In the Cascade portion of this province, habitat management is guided by the provisions of the Northwest Forest Plan (NFP) (USDA, USDI 1994). Under the NFP, the 1,007,500 acres of National Forest and Bureau of Land Management lands in the province are divided into several land allocation categories, including extensive late-successional reserves (LSR), managed late-successional areas, adaptive management areas, riparian reserves, and general forest matrix, as well as Congressionally withdrawn lands such as wilderness areas (USDA, USDI 1994). Large LSRs are intended to provide long-term habitat for species associated with late-successional forests. Reserved land allocations intended to provide long-term habitat for species associated with late-successional forests account for 647,100 acres (64%) of the Federal land base within the province. LSRs account for 235,325 acres of the Reserved Lands, and support 51,556 acres (21%) of late-successional habitat (USDA, USDI 1994). Under the NFP, no additional management for goshawks is required. The proportion of mature forest habitat (and potential goshawk habitat) within Reserved Areas within the California Cascades province is likely to increase as second-growth stands mature.

On private industrial timberlands, Habitat Conservation Plans are being developed. These plans contain management strategies to conserve forest-associated wildlife species, particularly northern spotted owls (Cascades) and California spotted owls (Sierra Nevada). The HCPs are anticipated to provide additional long-term habitat for an undetermined number of northern goshawk territories.

Modoc Plateau Province

This province consists of the relatively flat volcanic upland extending from the California Cascades east to the Warner Mountains, and from the Oregon border south to the Pit River drainage and into the lowlands of the Lassen National Forest. The dominant forest cover type in this province is ponderosa pine, with pine/white fir and mixed conifer on uplands. Forest habitats are interspersed with large areas of juniper woodland and sage-steppe habitat.

Prior to euro-American settlement, ponderosa pine forests dominated the Modoc Plateau in the 4,000-6,500-foot elevation range. Frequent low-intensity wildfire played an important role in maintaining open stand conditions and grassy understories (Laudenslayer *et al.* 1989).

A significant reduction in mature ponderosa pine forest has occurred in this area. By 1950, approximately 20% of the historic mature forest area had been harvested (Laudenslayer and Darr 1990). Perhaps as important as removal of mature timber has been the effects of fire suppression in this forest type. Large areas of second-growth ponderosa pine exhibit high densities of small trees, high canopy closure, and ingrowth by white fir (Laudenslayer *et al.* 1989). Currently, less than 5% of the Eastside pine area of the Klamath National Forest is in late-successional condition. On the Modoc National Forest, approximately 6% of Eastside pine forest is in mature or old-growth condition (USDA 1991). The area of nesting and foraging habitat for goshawks has likely declined from historical levels, although the magnitude of such change is unknown.

Increased protection of forest habitats within the ranges of the marbled murrelet, northern spotted owl and California spotted owl has resulted in more emphasis on timber production in Eastside pine forests. The forest plan for the Modoc National Forest (1991) predicts further reduction in area of mature ponderosa pine, from the current 6% to 2% during the first decade of the plan. By the 5th decade of this plan, an estimated 70% of suitable timberlands will be in plantations and sapling-small tree seral stages (USDA 1991). The proportion of this area that will provide suitable goshawk habitat is unknown, but it is likely that the amount of mature forest habitat used by nesting and foraging goshawks in pine forests will decline. Eastside pine habitats on the Klamath National Forest lie within the Gooseneck Adaptive Management Area (AMA). Although a Management Plan for the AMA has not been completed, the guiding emphasis for the AMA is development of natural mature ponderosa pine habitat. As the existing large acreage of younger pine and pine/white fir stands mature over time, it is likely that the area of potentially suitable goshawk habitat will increase.

California Klamath Province

This province consists of the Klamath, Siskiyou, and Salmon mountains, extending from the Oregon border south to the Clear Lake Basin in the Inner Coast ranges. Mixed Douglas-fir forests dominate the area, varying from dense Douglas-fir/tanoak forests in the mesic western portion of the province, to Douglas-fir/ponderosa pine and Douglas-fir/oak associations in drier eastern sites. At higher elevations, white and red firs mix with Douglas-fir. In the southern portion of the province, Douglas-fir occupies canyons and north slopes, with chaparral, oak woodlands and canyon live-oak in the uplands.

Under pre-settlement conditions, a large proportion (>70%) of the Klamath Province supported forest cover (USDA 1992). Since the mid-1940's, 25 to 40% of historic dense mature forest habitat in the Klamath Province has been removed from the 4 National Forests in the province. Harvest levels dropped significantly in the late 1980's, and have remained low in the 1990's, largely due to Federal restrictions related to northern spotted owl management. Despite extensive past logging, potentially suitable habitat for goshawks remains abundant and well-distributed in most of the Klamath Province, and includes 2,406,600 acres of Federal lands (USDI 1992).

The Klamath Province lies entirely within the range of the northern spotted owl, and is managed under the provisions of the Northwest Forest Plan. Reserved Areas account for approximately 80% of the Federal lands in this province. These areas include LSRs, riparian reserves, managed LSRs, and Congressionally Reserved and Administratively Withdrawn Areas such as Wilderness (USDA, USDI 1994). As younger stands within these protected areas mature, the amount of potentially suitable habitat for goshawks is likely to increase. The primary future threat to this

habitat is catastrophic wildfire in large areas currently exhibiting high fuel levels and fire risk (USDI 1992). Therefore, fuels reduction and prescribed fire are important aspects of implementation of the NFP.

On private industrial timberlands, management of forest habitats for goshawks and other forest-associated wildlife will be guided by Habitat Conservation Plans and will likely include measures for managing goshawk territories.

North Coast Range Province

The California Coast Province extends from the Oregon border to San Francisco Bay, and from the ocean to the western boundaries of National Forest lands. The dominant forest cover types are redwood, sitka spruce/western hemlock, and Douglas-fir.

Early logging of forests in the Coastal Province, particularly valuable redwood forests, was facilitated by a number of factors, including gentle terrain and ease of access, and close proximity to coastal ports. The decline of late-successional redwood was rapid and nearly complete. In coastal floodplain areas, conversion of forest to agricultural and residential uses also resulted in fragmentation of redwood and sitka spruce/hemlock forests. Of the 1.4 million acres of late-successional redwood stands estimated to exist historically, only 6% remained in 1992 (USDI 1992). Abundant moisture and rapid regeneration by stump-sprouting redwoods, however, permitted development of large acreage of mid- to large diameter second growth redwood stands. Inland from the redwood belt, harvest of Douglas-fir stands for lumber and of tanoak (an understory associate of Douglas-fir) for tanbark also occurred at the turn of the century.

Federal lands currently constitute about 471,000 acres within the Coastal Province, of which 1% is classified as small conifer (9-20.9 inches dbh) and 7.5% is medium/large conifer (>21 inches dbh). Little information is available to permit estimation of current amounts of potential goshawk habitat on private lands within the Coastal Province.

The dominance of private ownership in the Coastal Province makes prediction of future trends in potential goshawk habitat difficult. Future management of forests within the province will be determined by State of California Forest Practice Rules and by HCP agreements between private landowners and USFWS. Federal lands account for only 471,300 acres within this province, 84% of which are in National Parks, late-successional reserves, and other reserved land allocations under the Northwest Forest Plan. Only 13% of these reserved lands are currently in late-successional condition; an unknown proportion of these acres may provide habitat for northern goshawks.

Habitat Conservation Plans under development on private industrial forestlands will likely provide management guidelines for northern spotted owls, goshawks and other forest-associated wildlife. In the North Coast Ranges Province, HCPs currently affect approximately 1,171,200 acres of forest.

Southern California/Central Coast Ranges Province

This province lies within the southern half of California, and includes the Southern Transverse Ranges (San Gabriel, San Bernadino, San Jacinto and Clark mountains) and the Central Coast ranges (Santa Cruz, Santa Lucia and Santa Ynez mountains) as well as scattered smaller ranges.

These ranges are somewhat isolated from the Sierra Nevada and other major mountain ranges. Forest cover types within the province include riparian hardwood forest, live oak/bigcone Douglas-fir forest, mixed conifer forest, and redwood/California-laurel forest (Verner *et al.* 1992). Well-developed coniferous forest structure typically associated with goshawk occupancy in the western United States is very limited in distribution, found largely at higher elevations in Jeffrey pine and lodgepole pine stands.

The distribution and species composition of coniferous forest habitats in the Southern California Province appear to be similar to those seen today (Verner *et al.* 1992). Early logging in southern California forests was limited in extent, but large fires associated with mining may have removed significant amounts of lower-elevation Douglas-fir forest (Verner *et al.* 1992).

Logging intensity in Los Angeles and San Bernadino counties declined significantly between the period from 1955 to 1977 (10-25 million board annually) and post-1980 (0-3 million board feet) (Verner *et al.* 1992). Current Land Management Plans for the four southern California National Forests emphasize recreation and habitat maintenance, and subsequent low timber volume targets. Potential goshawk habitat in higher elevation coniferous forest in this province is likely to remain stable over time.

Conclusions regarding goshawk habitat trends in Assessment Area 5

Changes between historical and current habitat:

Changes have occurred in the distribution, amount, and structural characteristics of mature forests throughout much of California. The primary change has been reduction of mature forest cover by logging, although other factors such as catastrophic fire have also been implicated. Although the extent to which goshawk populations are correlated with amounts of mature forest cover is unknown, there clearly has been a significant reduction in the amount of habitat often associated with goshawk nest sites. Other changes such as grazing and suppression of wildfire have had an important, but more subtle effect on the structural characteristics and ecological processes of California's forests. At the landscape level, all of these changes may affect foraging habitat structure, prey abundance, and development of future nesting habitat for goshawks.

Changes between current and future habitat:

Throughout much of California, the nature and rate of loss of mature forest habitats has declined significantly during the past 2 decades. Public debate over management of forest resources has resulted in regional forest management strategies such as the Northwest Forest Plan and CASPO interim standards and guidelines, which focus on retention and restoration of mature forest habitats on Federal lands. These changes are reflected in the declines in timber volume sold on National Forest Lands in California, although in areas not covered by regional plans, (e.g., Modoc Plateau and parts of the Cascades), some harvest of mature forest habitat continues.

Despite a general reduction in rate of harvest of mature timber on public forestlands, it is difficult to project future habitat trends for goshawks in California. Implementation of regional ecosystem plans will be key to developing and maintaining the nesting and foraging habitat requirements of goshawks. In drier habitats in the eastern Klamath, Sierra Nevada, Cascade and Modoc Provinces, factors such as fire management and its effects on stand structure may be important to long-term habitat quality. In general, the trend toward reduced harvest of mature forests in this

assessment area should benefit goshawks over time.

Assessment Area 6

Introduction and Current Habitat as Modeled by FIA data

Assessment Area 6 includes the states of Washington and Oregon (see Figure 9). Table 45 provides an initial view of the potential forest vegetation, by ownership, in this Assessment Area.

Table 45. Forest Cover Types, by Land Manager/Owner - Assessment Area 6

Forest Type	Indian Lands	National Forests	Bureau of Land Mgmt	Nat'l Park Service	Fish and Wildlife Service	Other Lands*	Total
Douglas-fir	173,000	7,221,000	4,632,000	371,000	3,000	6,720,000	19,120,000
Fir-spruce	90,000	3,588,000	22,000	912,000	1,000	125,000	4,738,000
Hemlock-Sitkaspruce	149,000	456,000	373,000	144,000	4,000	3,177,000	4,303,000
Larch	144,000	496,000	113,000	1,000	26,000	172,000	952,000
Lodgepole pine	170,000	2,049,000	167,000	21,000	12,000	261,000	2,680,000
Pinyon-juniper	15,000	254,000	377,000		22,000	112,000	780,000
Ponderosa pine	1,189,000	9,970,000	1,589,000	151,000	45,000	2,625,000	15,569,000
Redwood		35,000	2,000			11,000	48,000
Western hardwoods	17,000	243,000	198,000	58,000	1,000	882,000	1,399,000
Western white pine	18,000	167,000	43,000		3,000	36,000	267,000
Total	1,965,000	24,479,000	7,516,000	1,658,000	117,000	14,121,000	49,856,000

Habitat Trends

Washington

In Washington, forests cover about 21,000,000 acres or 50 % of the state. About 18 million acres are considered productive commercial timberlands. Forest ownership of commercial forests is split among National Forest (29%), forest industry (29%), miscellaneous private owners (19%), other public of which most is state (15%), and Native American (8%) (Bolsinger *et al.* 1997). Over 85% of the timberlands are conifer forests dominated by Douglas-fir with lesser amounts of ponderosa pine, western hemlock, coastal Sitka spruce, true firs, and lodgepole pine. Dominant hardwoods including red alder, bigleaf maple and black cottonwood covered about 12 % of timberlands during the period 1988-1991 (Bolsinger *et al.* 1997).

Oregon

Oregon forest lands cover about 28,000,000 acres or about 46% of the land area. About 22 million acres are considered productive timberlands (Lettman 1988). Forest ownerships are split among National Forests (48%), Bureau of Land Management (10%), forest industry (20%), non-industrial forests (16%), other public of which most is state (4%), and Native American (2%). Forest composition is similar to Washington with larger amounts of lodgepole pine and western larch in eastern Oregon.

Forest Habitat Status in Assessment Area 1

Assessment Area 1 is characterized by a diversity of ecological forest conditions ranging from rainforest-like landscapes on the Olympic Peninsula to sparsely forested high desert aspen and juniper groves of southeast Oregon (Table 45). Within Area 1, the larger Federal land management categories include 24 National Forests, 10 BLM Districts, 4 National Parks, and 5 larger tribal reservations.

For analysis purposes, western and eastern Washington and Oregon are treated separately because of differences in plant communities, resulting from climate and geological history. These same differences have led to their separation in most studies and large scale planning efforts. In many cases the data from different studies are not comparable because of different management unit boundaries, management assumptions, and time frames addressed.

Western Washington and Oregon

Significant changes on forested lands have occurred in the western portions of both states since settlement of the northwest by early pioneers in the 1840s (Jackson and Kimmerling 1993). Bolsinger et al. (1997) estimated that over 2,000,000 acres of forested lands have been lost to road construction and urban expansion in Washington alone, the majority of which has occurred in the Puget Sound area.

Booth (1991), using 1933 data, estimated western Oregon and Washington old-growth (forests >200 years old) at 10.5 and 9.1 million acres respectively prior to extensive logging, compared to 1.8 and 1.7 million in the 1980s. Overall this represents an 83-84% decrease in older forests due to logging, fires and land conversions (e.g., urbanization, roads) during this 50-year time frame. The primary approach to forest management during this period for all ownerships was clearcut logging and intensive reforestation with one or more species, predominantly Douglas-fir. Forest industry lands in both states are now mostly covered with early seral stand conditions and generally are managed on short rotations (Bolsinger *et al.* 1997, Lettman 1988).

More comprehensive estimates of current forest stand conditions were developed for Federal land management planning within the range of the northern spotted owl (USDA and USDI 1994). For single and multi-story stands with trees 21 inches in diameter or larger on Federal lands in western Washington and western Oregon respectively, about 1,650,000 acres and 2,985,000 acres remained. This constitutes about 42% of the total Federal land base, the majority of which are located in the Cascade Mountains of both states. Of approximately 8.2 million acres of forest industry lands within the entire range of the northern spotted owl (including California), about 90% of the acreage are in stands under 80 years old and most are under 60 (USDA and USDI 1994). On state forest lands in western Oregon about 87% of all forests are under 80 years of age (Oregon Dept. of Forestry 1995, 1998), and on State Department of Natural Resources lands in

Washington within the range of the northern spotted owl about 75% of existing forests are under 80 years of age (Wash. Dept. of Natural Resources 1997).

In summary, Federal, state and private lands have been heavily logged and fragmented with road systems since the early 1900s. Most remaining mature and older forests are found on Federal lands in the Cascade, Olympic, and southern Oregon Klamath mountains (USDI 1992, USDA and USDI 1994).

Under the Northwest Forest Plan about 13,500,000 acres or 73% of Federal lands in Washington and Oregon will be managed as Congressional reserves, late-successional reserves and riparian reserves. These reserves further connect with an additional 3.8 million acres of similar reserves in northern California. Further, 100 acres of late-successional forest habitat is to be maintained within forest matrix lands around all spotted owl activity centers known prior to 1994, and managed late-successional areas are to be maintained around 12 activity centers on the eastside of the Washington Cascades. Managed late-successional areas are located in areas of high fire frequency and are designed utilizing median home range size for that physiographic province.

Eastern Washington and Oregon

Similar forest changes have occurred on Federal forest lands in eastern Washington and Oregon. Productive timberlands total approximately 2.5 and 5.5 million acres respectively out of a total of 15,000,000 acres of Federal forest lands. Most are National Forest lands but included are about 182,000 acres of forested BLM lands primarily in south central Oregon. As a result of a 1993 Presidential directive, the Forest Service and BLM have been developing an ecosystem-based strategy for eastside forests and rangelands (Quigley *et al.* 1997). All Federal lands east of the Cascades in Washington and Oregon as well as portions of all other states in the entire Columbia River basin, have been undergoing intensive study and analysis for the past 4 years as part of the Interior Columbia Basin Ecosystem Management Project (ICBEMP) (Quigley *et al.* 1997).

As a part of the scientific assessment for the basin, dominant vegetation was mapped and analyzed by potential vegetation group (PVG) (Quigley *et al.* 1996). Five of 14 terrestrial PVGs were classified as forested including alpine, cold (higher elevations), dry, moist, riparian, and woodland. These six groups cover about 25% of eastern Oregon and Washington. Forested communities, excluding riparian and woodland, were further divided into early, mid-, or late seral forests. Of the 12 possible seral combinations, 8 showed what was considered ecologically significant change from historical vegetation across the basin. Upland woodlands also showed significant change. The average amount of change was about 55% among the various forest and woodland combinations. The largest changes included significant decreases in both early and late-seral lower montane forest and a corresponding increase in mid-seral lower montane forest (Quigley *et al.* 1996).

Eastern Washington and Oregon forests have undergone similar and extensive forest changes. As part of the Interior Columbia Basin project, an assessment was made of all resources including forest and range lands (Quigley *et al.* 1996). In comparing historical to current conditions the assessments determined that: 1) since the early 1800s there has been a 27% decline in multi-layered and 60% decline in single-layer old forest, particularly in ponderosa pine and Douglas-fir forest types; 2) mid-seral multi-layered stands increased by 12-55% in potential vegetation groups; and 3) disease and fire susceptibility have increased by 60%. In short, timber harvest

selectively removed old-forests and fire exclusion promoted the transition of early stands to mid-seral forest structures (Quigley *et al.* 1996 and 1997). Except in reserved land, extensive road systems now bisect all forested lands. As noted under future conditions below, considerable efforts have been initiated to reverse these unnatural changes and begin restoring ecological structure and processes to the region.

The large scale assessment of the interior Columbia Basin has resulted in the development of the Eastside Draft EIS for the entire Columbia Basin (USDA and USDI 1997). For eastside forests within the range of the spotted owl (e.g., Wenatchee, Deschutes, Winema) that overlap with the ICBEMP, the Northwest Forest Plan would continue to provide current direction. Until a preferred alternative is selected later this year, interim management strategies (also known as “eastside screens”) have been implemented to initiate ecosystem-based management with new timber sales. This includes specific efforts to accelerate restoration of both terrestrial and riparian ecosystems (USDA 1994) and protection of known goshawk nest site and post-fledging areas.

Conclusions regarding goshawk habitat trends in Assessment Area 6

As a result of the adoption of the Northwest Forest Plan, timber harvests on Federal lands within the range of the northern spotted owl in both western and eastern portions of the Assessment Area have dropped from an average of 4.5 billion board feet (bbf) per year in the 1980s to 1.1 bbf per year over the 10-year life of the plan (Tuchmann 1996). This represents a 76% drop in the Federal land timber harvest from the 1980s within the range of the northern spotted owl. Future scheduled timber harvests are directed to the “matrix” lands and forest stands outside of reserves. The matrix lands cover only 16% of the Federal lands within the Northwest Forest Plan area. For matrix lands the Northwest Forest Plan also includes provisions for maintaining blocks of late-successional forest distributed throughout the landscape to provide for spotted owl dispersal and connectivity. Silvicultural treatments will be allowed in some reserved and adaptive management area lands but only to accelerate restoration of functional late-successional forests.

The Northwest Forest Plan teams evaluated impacts of plan implementation on many plant and animal species associated with late-successional forests within the plan area. For the alternative that was adopted and is being implemented on Federal lands in the range of the spotted owl, the northern goshawk was rated as having a 100% likelihood of having sufficient quality, distribution, and abundance of habitat to allow the species’ population to stabilize well-distributed across Federal lands regardless of current population status (USDA and USDI 1994). This rating, conducted by a panel of scientists, reflects a high degree of confidence that the network of large reserves together with management direction between those reserves will improve and sustain goshawk populations in this area.

For eastern Oregon and Washington, an expert panel rated species outcomes according to their likelihood of viability under historic, current and future management scenarios. The goshawk rated near the median on Federal lands under several likely alternatives that included active management, habitat restoration and adaptive management, but a significant decline was predicted under current management plans (Quigley *et al.* 1997). It was noted that species respond to habitat changes at finer scales than the above evaluation. However, as indicated earlier, Federal forest management has already moved to a more ecologically based direction on all eastside spotted owl forests, and interim direction is in place on remaining Federal forest lands. Since 1993, under the eastside screens which are applied outside of the Northwest Forest Plan area

(USDA and USDI 1997), all known and historical goshawk nests are to be protected with 30-acre buffer and 400-acre post-fledging areas. These requirements are to be incorporated into forest plans until the Eastside EIS is completed sometime in the next year.

In summary, harvest has declined significantly in the last decade, and should continue to do so. With the changes in timber management on Federal lands within this assessment area, the Service expects continued improvement in forested habitat for goshawks.

Habitat Destruction and Modification

Timber Harvesting

Very few studies of goshawk habitat have had sufficient survey effort, sample size, or statistical rigor to demonstrate changes in goshawk behavior or nest success resulting from a particular timber harvest activity. Crocker-Bedford (1990) reported declines in the number or density of goshawk territories in areas that had been selectively harvested, however this result has been disputed by continuing studies in the same area (Reynolds and Joy 1998). The Service received reports of goshawks abandoning nest sites subsequent to timber harvest activity in nearby stands; often the nest sites remained unoccupied for several years following treatment. In many cases a local timber harvest may have resulted in relocation of the nest site 0.2 to 1.0 mile away, or a shift in foraging area; these territories are typically classified as “abandoned” based on inadequate survey of the previous nest stand. On the other hand, some of these reports described extensive removal of the overstory at the nest site and in much of the surrounding landscape. Clearly there is some level of habitat change that will render a landscape unsuitable for occupancy and reproduction by goshawks.

The spatial relationships among different functional levels of habitat use by goshawks (nest site, nest area, post-fledging area, foraging areas) are important considerations in assessing effects of timber harvest on goshawk habitat. Depending on the ecosystem or forest type, a landscape may only need to provide small amounts of nest area habitat if adequate foraging habitat is provided in the ‘matrix’ of other habitats (example aspen/shrubsteppe, eastside ponderosa pine). In other systems, large areas of mature forest (“nest habitat”) may be required to provide adequate prey resources (example Douglas-fir/hardwood forest). Any assessment of effects of timber harvest on goshawk populations should be based on careful evaluation of local forest conditions, important goshawk prey species and their habitat requirements, and natural forest processes and disturbance regimes at the local scale.

Nest Habitat - structure

Goshawk nest habitat is often characterized as mature to old-growth forest composed primarily of relatively large trees with relatively high canopy closure (60-80%) (Reynolds *et al.* 1982, Moore and Henny 1983, Mannan and Meslow 1984, Speiser and Bosakowski 1987, Woodbridge 1988, Marshall 1992, Crocker-Bedford 1990, 1994, Patla 1991, Reynolds *et al.* 1992, Ward *et al.* 1992, Squires and Ruggiero 1996). Most studies of nest site or nest area habitats used by goshawks in the western United States demonstrate an association with denser stands of larger trees, relative to what is available in the landscape. The basic structural attributes of these suitable nest stands are easily quantified, and local or regional standards based on existing nest sites are available for many forest types or localities. While silvicultural prescriptions may be employed to maintain stand structure within the range of stand density, tree size and canopy closure associated with

goshawk nest areas, this is rarely the objective of commercial timber sales. In practice, economic and logistical considerations of commercial timber operations typically require that timber harvests remove a significant proportion of the trees from a sale unit. Therefore, to estimate “losses” of potential nest habitat, comparison of expected post-harvest stand density and canopy closure to local definitions of ‘mean’ structural attributes of nest area habitat is necessary.

The effect of timber harvests on goshawk nest habitat can be described as the number of acres of potentially suitable forest (meeting local definitions from nest habitat studies) that are modified to a condition no longer meeting the definition. In forest types where goshawk nest areas are characterized as having very high canopy closure, most harvests will reduce canopies to below definition. In more open forest types (ponderosa pine, Jeffrey pine) light thinning of smaller trees (thinning from below) may occur without significantly altering the canopy, maintaining suitability for nest area habitat. Desimone (1997) found that goshawks in Oregon were more likely to persist in territories having a high percentage of mature and older forests (about 50%) in closed-canopied conditions within 52 ha (128 ac) around the territory center. He suggests that it is important for the persistence of nesting goshawks that little or no habitat alteration occur within aggregate nest stands. Bright-Smith and Mannan (1994) state that tree harvest methods which create large areas with reduced canopy cover (<35-40%) may be particularly detrimental. Reynolds (1989) states that practices such as selective overstory removal or patch and clear-cut harvesting, which result in either a complete removal of trees or in a reduction of the stem density and canopy volume throughout management units, threaten goshawk nesting habitat. Reduction of canopy closure may have several effects on goshawk nesting success, including increased solar radiation and subsequent heat stress, reduced buffering from adverse weather, and increased visibility to predators.

Another potential effect of timber harvest is removal of larger trees that may provide nest platforms. Farber *et al.* (1998) report that in managed stands where larger trees were lacking, nesting often occurred in deformities such as “fork tops” or mistletoe clumps. Harvest practices that eliminate these structures from stands may be expected to reduce nesting opportunities for goshawks, even if much of the forest canopy is retained.

Nesting Habitat - amount and patch size

While much is known about structural attributes of forest stands used for nesting by goshawks, relatively few studies have addressed the amount or patch size that the hawks may be selecting, and whether this habitat represents selection of a buffer of “nest site habitat” larger than what is actually used at the nest, or simply the forested area that happens to surround the nest site. Based on observations of feathers, whitewash, and prey remains, Reynolds (1988) defined an area (approximately 30 acres) of intensified use surrounding the nest as the “nest area;” this area has often been interpreted by land managers as the total area of nest habitat needed by reproducing goshawks. In studies by Woodbridge and Detrich (1994), occupancy rates of forest stands used for nesting decreased as stand size decreased, suggesting that the hawks were selecting larger (85 to 200-acre) stands. However, in many cases small (30 to 60-acre) stands were used successfully. The larger area (approximately 420 acres) of relatively denser forest surrounding nest areas that is used by the newly-fledged young during the “post-fledging dependency period” (Kennedy *et al.* 1994) further illustrates that larger patches of mature forest surrounding goshawk nests can be important.

The extent (spatial scale and treatment intensity) of timber harvest within a given landscape will affect the availability of suitable habitat patches for occupancy by nesting goshawks. This effect will depend on the forest type, and pre-harvest condition of the landscape. For example, two 50-acre clearcuts within a goshawk home range may only slightly affect the availability of nest habitat, whereas two 200-acre thinnings may degrade all of the available stands to conditions below structural characteristics of nest area habitat.

Nesting Habitat - physiographic location

Assessment of habitat availability for goshawk nest areas is often made at broad scales, following an assumption that presence of forest habitat meeting certain structural criteria will meet the needs of goshawks. However, there is evidence to suggest that location of goshawk nest sites is affected by landscape features such as slope, aspect, riparian vegetation, meadows, drainages, water, and other features. In northern California, nest sites were located on gentle north-east slopes, near streams, and closer to meadows than random sites (Allison 1996, Laacke and Flores unpub.); these associations have been reported by numerous other authors as well.

Foraging Habitat

There is little in the literature specifically defining the habitats used for foraging by goshawks. It may be reasonable to assume that timber management practices known to impact the quantity and quality of habitats associated with goshawk prey species are likely to impact goshawk foraging (Reynolds *et al.* in press). Also, there is evidence to suggest that goshawks, as large-bodied, visual predators, avoid overly dense habitats where physical or visual access to prey is limited. Beier and Drennan (1997) found that prey availability, as influenced by the density and structure of forested habitat, may be the more important factor when evaluating quality of foraging habitat. Habitat management practices, particularly fire suppression activities, that allow forests to become too dense for flight below or within the canopy are likely detrimental (Reynolds 1989). Such overly dense forest structures would limit goshawk detection of and access to prey. In such cases, harvest practices such as light thinning may actually improve or create foraging habitat for goshawks.

Telemetry studies (Beier and Drennan 1997, Austin 1993) suggest that goshawks select mature forest stands with open understories for foraging; however, it is likely that actual foraging habitat selection occurs at spatial and temporal scales difficult to investigate using radio telemetry. Small openings, treefall gaps, edges, riparian zones, and rock outcrops are examples of small-scale landscape elements that are used by foraging goshawks (Squires and Reynolds 1997), the use of which is difficult to detect through radio telemetry. Analyses of prey used in naturally open habitats demonstrate that goshawks will forage away from forest cover if suitable prey are available (Younk 1996, Woodbridge and Detrich 1994, McCoy 1998). However, it cannot be assumed that adequate prey will be available in openings created by timber harvests. In mesic habitats, removal of forest cover often results in dense regrowth where goshawks would be unlikely to detect or capture prey. In most forest habitats, silvicultural prescriptions that maintain some overstory structure would be expected to also maintain populations of forest-associated prey species. However, populations of many prey species are linked to structural attributes such as snags, large logs, large trees (cone crops, mistletoe, etc.), soil organic horizon depth (fungi) and hardwoods (mast) which may not be maintained under various silvicultural prescriptions, unless the prescription is specifically designed to maintain them.

Much of the current literature suggests that goshawks are food-limited. However, current understanding of how foraging habitat may limit goshawk populations is not clear (Reynolds *et al.* in press). In low quality habitats, prey populations may be low (poor abundance) or unavailable (poor habitat quality), resulting in poorer goshawk health (greater predisposition for disease) and reproduction, greater interspecific competition for food, and greater susceptibility to predators (Reynolds *et al.* in press). In interior Alaska, where diets of nesting goshawks are dominated by a single species, the snowshoe hare, McGowan (1975) showed that fluctuations in the density of hares over a 10-year period coincided with changes in the number of active goshawk nests and the production of fledglings. Food availability may affect the distribution and abundance of raptors, their territory or home range sizes, the proportion of pairs breeding, nesting success and fecundity (Schoener 1968, Southern 1970, Galushin 1974, Baker and Brooks 1981, Smith *et al.* 1981). Low food abundance during winter may cause goshawks to leave their breeding home ranges and preferred foraging habitats, for areas where they might be exposed to greater mortality. If food availability remains low in early spring, adults may enter the breeding season in poor condition, males may not be able to find enough food to feed their mates, and egg laying may not occur or may be delayed and clutches abandoned. Shortages of food during the nestling period can result in females leaving their broods unattended to help males forage (Reynolds 1972, Ward and Kennedy 1997).

Points Raised by the Petitioners

The petitioners discuss at length the habitat requirements for goshawks in the forested west, referred to it in the petition as “critical” habitat. They cite Bent (1937) to support their contention that goshawks depend on extensive forests with large old-growth stands, and point out that old-growth has declined substantially due to extensive logging. The Service concurs that much of the “old-growth” forest throughout the west has declined, and that what remains of this important forest age class should be managed carefully. Relative to goshawk use of habitats, the Service finds that while most studies suggest that goshawk nests appear to be associated with stands relatively larger and denser than what is generally available in the landscape, few studies actually demonstrate selection, and few discuss how much habitat is needed or demonstrate changes in goshawk populations associated with changes in habitat. Goshawks do use mature forest, but it is not clear how much is needed or to what extent younger or more open stands are used. The fact that goshawks continue to occur in areas with documented loss of high proportions of old-growth habitat indicates that goshawk habitat needs are more complex than only the requirement of old-growth forest. Based on the best current available information, the Service is unable to establish that goshawks are dependant on large tracts of old-growth for population viability.

The petitioners further state their belief that goshawks depend on large trees for nests, perching, and microclimate, and that superior foraging habitat is provided by closed-canopied stands. While the Service agrees that, at least in some geographic areas these types of stands are important in the areas immediately surrounding the nest, it is not documented that dense-canopied stands are required throughout the majority of the home range in all forest types. Extensive areas of lower elevation mixed conifer and ponderosa pine forest of the Sierra Nevada and Cascade ranges, and the Modoc Plateau were logged early in this century and do not currently support mature conifer forest in significant amounts. However, in some of these areas, goshawk territories are centered on remaining fragments of mature forest that exist in a mosaic of other forest types and age classes (Allison 1996). While goshawks are absent from areas lacking these residual stands of

mature forest, there appears to be enough nesting habitat on the Modoc Plateau to support a well-distributed population at densities comparable to studies elsewhere in North America (Woodbridge, USDA Forest Service pers. comm. 1998). In addition, the highest density of goshawks reported in the literature for North America, is on the Kaibab Plateau of northern Arizona, an area that experienced significant logging pressure, although the Plateau was not logged extensively by railroad companies by the early part of this century as were other parts of northern Arizona (Reynolds and Joy 1998).

The petitioners state that salvage logging caused “heavy losses” of goshawk habitat in the Pacific Northwest, northern Rockies, and southern Utah. However, they provided no quantitative or other evidence to bolster that claim, and do not state what effect they believe salvage logging has had on northern goshawks.

Reynolds and Meslow (1984) are cited as evidence that fires and logging have eliminated the goshawk as nesters in northwestern Oregon. However, the absence of goshawks in the Oregon Coast Ranges (exclusive of the Siskiyou Mountains in southwest Oregon) was only hypothesized by Reynolds and Meslow (1984) to be related to: 1) loss of old forests to catastrophic fire; 2) past logging of old forests, and; 3) the tall and dense brush cover that occurs in these forests. Tall and dense understories likely prevent goshawks from detecting and capturing prey. Since the work by Reynolds and Meslow (1984), two goshawk nests and several possible nesting pairs have been located in intensive searches of old forests in the Coast Ranges (DeStefano and McCloskey 1997). The DeStefano and McCloskey (1997) study suggested that the natural and extensive shrub cover beneath forest canopies is the main factor limiting goshawks in the Oregon Coast Ranges. Nevertheless, there is no direct evidence that any of these factors are, in fact, preventing goshawks from nesting in the Coast Ranges. The relationship between logging and fires and the lack of nesting goshawks in the coastal forests is hypothetical.

Grazing

In addition to timber harvesting, livestock grazing has been identified as a cause of habitat loss and degradation in Nevada (Lucas and Oakleaf 1975), where goshawks nest in mature aspen, a habitat type used by goshawks in that state. Aspen stands are vulnerable to grazing because characteristics associated with nest stands (shade, water, and level ground along creeks and in swales) also tend to concentrate livestock (Reynolds 1989). In areas subjected to long-term, concentrated grazing, aspen sprouts are unable to survive, and replacement of mature overstory trees does not occur. Grazing also can affect the habitat used by key goshawk prey species; long-term grazing can reduce or eliminate the herbaceous and shrubby understories that provide important food and cover for prey species (Reynolds *et al.* in prep). Although livestock grazing can result in localized degradation of goshawk habitat, there is no evidence that grazing is a significant threat to goshawks throughout the petitioned area.

Conclusions

Habitat quality can be reflected in goshawk physical condition (body mass), nesting success and productivity, degree of fidelity to territory and mate, size of home range and population densities of both goshawks and prey species (Reynolds *et al.* 1994). The structure, function and quality of both nesting and foraging habitat can be negatively impacted by timber harvest operations that destroy nests and nest trees, modify or remove entire nest stands, remove overstory and older,

mature trees, and remove or decrease the number of snags and the amount of down wood available to goshawk prey. Timber management has been demonstrated to affect goshawks at least at local levels (Reynolds 1989, Crocker-Bedford 1990, Bright-Smith and Mannon 1994, Woodbridge and Detrich 1994, Beier and Drennan 1997, Desimone 1997). Reduction and fragmentation of mature forest habitat may favor early successional competitors and predators such as red-tailed hawks (*Buteo jamaicensis*) and great horned owls (*Bubo virginianus*) (Woodbridge and Detrich 1994). However, forest management practices, such as the use of controlled fire and selective thinning, can be implemented to make habitats more suitable to goshawks by opening up dense understory vegetation, creating snags, down logs, and woody debris, and creating conditions conducive to goshawks and their prey (Graham *et al.* 1997).

In conclusion, the Service believes that forest management (e.g., logging, fire exclusion) has profoundly changed the vegetation characteristics throughout most of the western United States. The Service further agrees that some areas that have been intensively logged may lack nesting goshawks, or support goshawks in densities below probable historical levels. However, the Service finds there is no documented evidence of extirpations in assessment areas, that goshawk habitat is limiting the overall health of the goshawk population within the petitioned area, or that a significant curtailment of the species' habitat or range is occurring. The petitioners rely largely on the claim that goshawks are dependent on large, unbroken tracts of "old-growth" and mature forest in their assertion that the species is in danger of extinction. However, neither the petition nor other information available to the Service supports this claim. Rather, the species appears to be a forest habitat generalist in terms of the variety and ages of forest types it will use to meet its life history requirements; goshawks use small patches of mature habitat to meet its nesting requirements within a mosaic of habitats in different age classes.

B. Overutilization for Commercial, Recreational, and Scientific purposes

Take of Individuals

Take of goshawks through shooting, trapping, poisoning or other means is generally illegal. The specific regulatory mechanisms protecting goshawks are discussed under Factor D. Take of goshawks through these avenues does not appear to be a significant factor affecting goshawk populations in general.

Falconry is one means by which live goshawks can be legally taken. Specific falconry regulations are discussed by State under Factor D, but as Table 46 shows, up to 60 goshawks per year are estimated to be taken throughout the western United States. While there may be some localized impacts to nesting goshawks, falconry take at this rate is not expected to have significant, negative rangewide effects on goshawk populations.

C. Disease or Predation

Predation

Evidence of predation on young and adults has been reported in nearly all studies of goshawks, although, in none of these studies do the authors suggest that predation appears to limit these populations. Goshawks are occasionally killed by large raptors (e.g., eagles, Squires and Ruggerio 1995; great horned owls, Rohner and Doyle 1992) and mammals (Doyle 1995, Paragi and Wholecheese 1994, Reynolds *et al.* 1997). Zachel (1985) and Rohner and Doyle (1992), also cited in Squires and Reynolds (1997), indicate that predation may increase during periods of low food availability. The great horned owl is perhaps the most important because of its wide distribution within the goshawk's geographic range, and its size, abundance, and capacity for preying on large raptors (Orians and Kuhlman 1956, Hagar 1957, Houston 1975, Luttich *et al.* 1971, McInville and Keith 1974). Although goshawks aggressively defend their nests against predators during the day, they are less capable of doing so at night. Thus, most reports of predation on goshawks by great horned owls are losses of nestlings, but adults are occasionally taken (Rohner and Doyle 1992). The effect of great horned owl predation on goshawk populations is unknown, but the owl's potential to affect the fecundity of large raptors is suggested by predation rates as high as 49% on nestling red-tailed hawks (Luttich *et al.* 1971). Because juvenile goshawks are inexperienced at predator avoidance, predation is likely to be more important in this age class than in adults (Reynolds *et al.* 1997 in prep). Kennedy (1997), notes that no data are available to determine long-term temporal trends in nestling mortality.

Great horned owls begin nesting earlier than goshawks and, on occasion, lay eggs on goshawk nests forcing goshawks to alternate nest sites. Because alternate goshawk nests are often close together (Reynolds *et al.* 1994, Detrich and Woodbridge 1994), goshawks and owls occasionally nest in close proximity. This proximity increases the potential for reciprocal predation on adults and young of goshawks and the owl (Rohner and Doyle 1992, Gilmer *et al.* 1983).

Even less is known about the extent of predation on goshawks during winter. Squires and Reynolds (1997) review reports of predation on goshawks, including instances by eagles during winter (Squires and Ruggiero 1995), by marten (*Martes americana*) in winter (Paragi and Wholecheese 1994), wolverine (*Gulo gulo*), and other predators (McGowan 1975, Ward and Kennedy 1996).

Competition

The extent to which goshawk habitat use is affected by interspecific competition for habitat is not known. Pairs of goshawks may be excluded from nest sites by other raptors, in which case goshawks may move to an alternate nest or, if other suitable nest habitat is not available, might be excluded from the area (Reynolds *et al.* 1997 in prep). It is not uncommon for goshawks and other raptors to nest close to one another (Reynolds and Wight 1978). Two potential competitors of the goshawk for nest habitat are the sharp-shinned hawk and Cooper's hawk. However, there is some partitioning of habitat, mostly on the basis of tree size and density within nest areas, by these species (Reynolds *et al.* 1982, Moore and Henny 1983, Sidders and Kennedy 1994). Because the goshawk is the largest of these species, it is more likely to exclude the smaller species from nest habitat (Reynolds *et al.* 1982, Moore and Henny 1983, Sidders and Kennedy 1994). Also, Cooper's hawks begin nesting later (Reynolds and Wight 1975).

Great horned owls, spotted owls, and great gray owls often use nests of goshawks (Forsman *et al.* 1984, Bryan and Forsman 1987, Buchanan *et al.* 1993). However, the intraspecific territorial behavior of these owls results in a dispersion of their nests (McInville and Keith 1974) making it unlikely that goshawks would be excluded from entire forest tracts unless other suitable nest habitat was not available.

Red-tailed hawks often nest in wooded habitats and are potential competitors for nests with goshawks. However, nests of red-tailed hawks tend to be close to forest openings (Spieser and Bosakowski 1988, Titus and Mosher 1981), high on ridges (Spieser and Bosakowski 1988, Titus and Mosher 1981), and in relatively open sites (Titus and Mosher 1981). Because goshawks typically nest lower on slopes and in sites where trees are relatively dense (Reynolds *et al.* 1982), competition between goshawks and red-tailed hawks for nest sites is likely to be low except, perhaps, in naturally open forests such as ponderosa pine or forests fragmented by meadows, burns, or clearcuts. During 6 years of studying goshawks on more than 100 territories in relatively open ponderosa pine and mixed-conifer forests on the Kaibab Plateau in Arizona, nest competition between this species and goshawks was not observed (Reynolds pers. obs.).

Several other species of hawks and owls, and numerous mammalian predators are potential competitors with goshawks for food. The Cooper's hawk forages in the same habitat and feeds on many of the same prey (Storer 1966, Reynolds and Meslow 1984, Bosakowski *et al.* 1992). The red-tailed hawk and great horned owl also prey on the same species eaten by goshawks, although neither has the same degree of dietary overlap with goshawks as does the Cooper's hawk (Fitch *et al.* 1946, Luttich *et al.* 1970, Smith and Murphy 1979, Janes 1984, Bosakowski and Smith 1992). Because both the red-tailed hawk is more abundant in open habitats (meadows, edge, forest openings, woodlands, Howell *et al.* 1978, Spieser and Bosakowski 1988), the extent to which they coexist and compete for food with goshawks probably varies by the openness of forest types and extent of natural and anthropogenic fragmentation of a forest.

In most North American forests, a variety of mammalian carnivores, including foxes, coyotes, bobcats and lynx, weasels, and martens, co-occurs with goshawks. These species feed on some of the same prey as goshawks such as rabbits, tree and ground squirrels, grouse, and other birds. The cumulative effects of predation by these carnivores on the abundance and distribution of goshawks, particularly in years when prey populations are naturally low, are unknown.

Conclusions

In general, goshawks have few natural predators, and the Service does not find evidence that predation is a significant mortality factor particularly in adults. As noted above, nestling and juvenile goshawks are incapable of or inexperienced at predator avoidance. Predation is, therefore, likely to be a more important mortality factor for these age classes than in adults (Reynolds *et al.* 1997 in prep). The magnitude of effects on goshawks of interspecific competition is not well understood. Fragmentation of forested habitats can make the affected areas more accessible and attractive to competing species such as red-tailed hawks and great horned owls, potentially decreasing habitat available to goshawks. But there is no evidence that this is a significant mortality factor goshawks in general.

Disease

Squires and Reynolds (1997) summarize information on diseases and parasites affecting goshawks. Their summary includes citations on tuberculosis (Lumeij *et al.* 1981), erysipelas (Schroder 1981), heart failure caused by *Chlamydia tsittaci* and *E. coli* (Ward and Kennedy 1996), and *Aspergillus* (Redig *et al.* 1980). Squires and Reynolds (1997), state that stress resulting from reduced prey abundance, migration during invasion years and agonistic interactions may increase susceptibility to *Aspergillus*.

Only one report of an epizootic in wild goshawks is found in the literature: Redig *et al.* (1980) reported aspergillosis (*Aspergillus fumigatus*) in 53% of 49 hawks and 7% of 45 goshawks trapped in Minnesota in 1972 and 1973, respectively. The authors believed that the trapped goshawks were birds emigrating from more northern forests due to low prey abundance there, and that the epizootic was the result of increased stress on the hawks related to increased agonistic interactions, reduced prey availability, and migration (Redig *et al.* 1980).

Squires and Reynolds (1997), also note that internal parasites are common and, citing Keymer (1972), that heavy infestations of ectoparasites like lice (*Degeeriella nisus vagrans*) usually occur in weakened birds. Greiner *et al.* (1975), cited in Squires and Reynolds (1997), found that approximately 56% of North American birds had blood parasites including *Leucocytozoon*, *Haemoproteus*, *Trypanosoma*, and *microfilariae*. Beebe (1974), cited in Squires and Reynolds (1997), suggested that “frounce,” a disease contracted by feeding on fresh pigeons, may threaten some goshawk populations in British Columbia, but data are lacking.

Based on the information available, the Service finds that there is no evidence indicating that disease is a major factor in the long-term health and survival of any North American goshawk population.

Points Raised by the Petitioners

The petitioners contend that in logged habitat great-horned owls and red-tailed hawks take over territories. They cite Zinn and Tibbitts (1990), Crocker-Bedford and Chaney (1988), and Crocker-Bedford (1990) to support the contention that goshawks are being supplanted by these two species on the NKR. However, Reynolds and Joy (1998) found no direct evidence that red-tailed hawks or great-horned owls had usurped goshawk nests or displaced goshawks from territories, although one case of a red-tailed hawk nesting in a possible goshawk nest was noted in 1997.

Conclusion

In conclusion, the Service believes that, while disease, predation, and competition have all been documented in the wild, there are no data to show that these factors have a significant effect on the likelihood of goshawk persistence in any area.

D. Inadequacy of Existing Regulatory Mechanisms

Federal Laws

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) provides the only Federal protection for the northern goshawk. Raptors, with the exception of eagles, did not receive any Federal protection prior to 1972, when the treaty with Mexico was amended. At that time, regulations for raptors became the responsibility of the Service under the authority of the MBTA. The MBTA makes it unlawful to pursue, hunt, take, capture, or kill in any manner any migratory bird. Protection under the MBTA includes prohibition of destruction of nests or eggs. The MBTA provides no protection to habitat.

National Forest Management Act

The National Forest Management Act (NFMA) governs management of National Forest System lands. Regulations implementing NFMA provide:

“Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area. For planning purposes, a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area. In order to insure that viable populations will be maintained, habitat must be provided to support, at least, a minimum number of reproductive individuals and that habitat must be well distributed so that those individuals can interact with others in the planning area.” 36 CFR 219.19.

The requirements of the NFMA, if fully implemented, would likely eliminate the need to list any vertebrates occurring to a large extent on National Forest lands. However, to fully implement NFMA provisions would require funding and personnel levels far in excess of current resources. For northern goshawks, maintaining “viable populations”, as defined above, would require knowledge of habitat requirements currently not well understood, and an inventory and monitoring program beyond the capacity that current budgets can realistically support. Considering that the goshawk is but one of thousands of vertebrate species on National Forest lands, meeting NFMA mandates presents a considerable challenge.

Nonetheless, some National Forests provide meaningful protection for northern goshawks. In four of the six Forest Service Administrative Regions in the review area, goshawks are considered “sensitive species,” which are recognized by the Forest Service as needing special management to prevent being placed on Federal or State lists. Such designation requires biological evaluations to consider potential impacts to the species of any proposed management actions. Forest Service Region 3 has amended the forest plans for its 11 National Forests to incorporate the Management Recommendations for Northern Goshawks (Reynolds *et al.* 1992). Interim guidelines for goshawks have been in place since 1992, and the Record of Decision implementing the final guidelines was signed in 1996. At this point, the Service believes that these management recommendations, if properly implemented, can provide a level of habitat protection necessary to maintain goshawks on the landscape over time in the Southwest. Goshawks remain widespread despite past management practices, and should increase in numbers with these improved

management plans.

State Laws and Regulations Including Falconry

Falconry is the sport of taking game with trained raptors and is a centuries old tradition. In the United States, falconry became well established by the early part of this century. In 1976, the Service promulgated regulations governing falconry. The regulations allowed for the development of state falconry programs to operate within rigorous Federal guidelines and requirements for entry into the sport, for facility and equipment standards, and for reporting and marking birds. About 60 species of raptors are protected by Federal regulations; 18 are of importance to falconry, including the northern goshawk (USDI 1988).

General Status

No state in the review area affords legal protection to the northern goshawk beyond protection provided by Federal laws (e.g., Migratory Bird Treaty Act). Eight of the 17 states in the review area recognize the goshawk as a sensitive, protected, or priority species or species of special concern in state policy. Of the nine states which do not recognize the goshawk as a sensitive species, five have no breeding records for the species.

Overview of Falconry Regulations in Review Area

Of the 17 states in the review area, 10 states reported estimated goshawk take for falconry, over the last 10 years, of 1-11 birds per year, with the highest take in California and the lowest in Oregon and South Dakota. One state, New Mexico, reported no take of goshawks since 1991 due to a moratorium on take of nestlings, and prior to 1991 approximately one bird was taken per year. Arizona had a moratorium on take of goshawks from 1991-1995 but since 1995 has allowed take of three birds per year. The remaining 5 states reported no goshawk take for falconry over the last 10 years because goshawks do not breed and are rare migrants in these states. Seven of the 17 states in the review area have a falconry quota for northern goshawks ranging from 3 to 70 birds per year. In these states, actual take has been well below allowed take. The maximum annual take across the review area has been approximately 60 birds.

Northern Assessment Area - Area 1

Status

In the Northern Assessment Area the northern goshawk is not afforded state legal protection beyond that provided by Federal laws (e.g., Migratory Bird Treaty Act). No breeding records exist for North Dakota, however, both Montana and Idaho consider it a Species of Special Concern (Table 46). For Montana this classification is used to highlight species for special consideration in land use planning.

Falconry Regulations

Legal take of northern goshawks is limited to licensed falconers in all states, however, only Idaho allows take by nonresidents under a limited quota that began in 1997 (Table 46). No nonresident permits have been issued to date.

Rocky Mountain Assessment Area - Area 2

Status

In this Area, northern goshawks are not afforded special state legal protection, and only Wyoming recognizes the species as a Species of Special Concern (Table 46). This classification is used to recognize that a species has restricted habitat needs and that additional information on its status needs to be obtained. No specific protection requirements are conferred.

Falconry Regulations

Legal take of northern goshawks is limited to licensed falconers in all states. Although it is legal to take this species in Kansas and Nebraska (in Nebraska, take is limited to immature birds only), no confirmed goshawk breeding records exist in these states and over the past 10 years there has been no take of the species in either state (Table 46). In Colorado, there is no information to indicate that actual take is significantly different than reported take. Non-resident take is not allowed in any state in this Area.

Southwest Assessment Area - Area 3

Status

In the Southwest, individual states do not afford legal protection to the northern goshawk beyond that provided by Federal laws (e.g., Migratory Bird Treaty Act) (Table 46). In Arizona, the northern goshawk is included on the Arizona Game and Fish Department's Wildlife of Special Concern (AGFD, October 1996 draft). This list, however, only serves as a policy guide. Species on the list are those whose occurrence in the state is or may be in jeopardy, or species with known or perceived threats or population declines.

Falconry Regulations

Legal take of goshawks is limited to licensed falconers in all four states. In Texas, the goshawk is accidental or a winter visitor only. Falconers may practice falconry with this species in Texas, but these birds are procured in other states. In the two states with breeding populations, Arizona and New Mexico, there is a quota on annual take (Table 46). In Arizona, there was a moratorium on falconry take of goshawks from 1991-1995. This moratorium was established because at that time known goshawk nests were few in number and largely restricted to the North Kaibab Ranger District in northern Arizona. Prior to 1991, Arizona falconers could take eyas and passage goshawks. Take was restricted to north of the Gila River (to avoid the putative subspecies, *A. g. apache*), but no take quota existed. One or two goshawks were taken per year. Increased goshawk survey efforts between 1991 and 1995 revealed a larger population fairly well distributed across Arizona's montane conifer forests. In the early 1990s two demographic studies were initiated in Arizona but results regarding the stability of these populations will not be available for several years. By 1996, many more breeding pairs were known to occur but population performance was unknown; the moratorium was lifted but a quota was placed on take of nestlings and immature birds. Take continued to be restricted to north of the Gila River. In New Mexico, concern for goshawk populations prompted a moratorium on take of nestling goshawks (immature birds are still legal for take) in 1991, which continues today. This moratorium has effectively reduced take from an annual average of 1.3 birds (maximum take was 5 1982) prior to 1991, to zero since 1991. In New Mexico, take is also restricted to avoid the putative subspecies, *A. g. apache*. Non-resident take of goshawks is not allowed in any state in the Southwest. There

is no information indicating actual take is significantly different than allowable take for this species.

Intermountain Assessment Area - Area 4

Status

In the Intermountain Assessment Area, states do not afford legal protection to the northern goshawk beyond that provided by Federal laws (e.g., Migratory Bird Treaty Act) (Table 46). Utah lists the goshawk as a Species of Special Concern on the Division of Wildlife Resource's Utah Sensitive Species List. The purpose of the List is to identify species in the state that are most vulnerable to population or habitat loss and is intended to stimulate management actions (e.g. development and implementation of a conservation strategy) to preclude Federal listing.

Falconry Regulations

Legal take of northern goshawks is limited to licensed falconers in both states. Both states have quotas on take but quotas apply only to take of nestlings; there are no quotas on immature birds (Table 46). Nevada allows non-resident take. There is no information indicating that actual take is significantly different than allowable take, but in Nevada some illegal take is suspected.

Pacific Southwest Assessment Areas - Area 5

Status

In the Pacific Southwest Assessment Area the northern goshawk is not afforded state legal protection beyond that provided by Federal laws (e.g., Migratory Bird Treaty Act) (Table 46). The species is classified as a Species of Special Concern by California Department of Fish and Game, however, this classification does not confer any special protection. Some habitat protection considerations are required under other state rules (i.e., forest practices).

Falconry Regulations

In California northern goshawks may be taken under permit by both resident and nonresident licensed falconers. Under state falconry regulations goshawks take is prohibited in the Lake Tahoe Basin (Table 46).

Pacific Northwest Assessment Area - Area 6

Status

In the Pacific Northwest Assessment Area the northern goshawk is not afforded state legal protection beyond that provided by Federal laws (e.g., Migratory Bird Treaty Act) (Table 46). In Washington the species is classed as a State Candidate for review for potential listing and a Priority Species under the Washington Department of Fish and Wildlife's Priority Habitats and Species Program. These classifications are used to draw emphasis to the species and suggest that protective measures or management guidelines are needed. For Oregon the species is classified as State Sensitive- Critical, a species for "which listing may be appropriate if immediate conservation measures are not taken" (Oregon Administrative Rule 635-100-040).

Falconry Regulations

Legal take of northern goshawks is limited to licensed falconers in both states and an annual take

of 12 birds is allowed in Oregon (6 nestlings and 6 immature birds) (Table 46).

Table 46. Northern goshawk state status, annual falconry quota and estimated annual take for falconry over the last 10 years in the petitioned area, by Assessment Area and State.

Assessment Area	State	State Status ¹			Falconry Quota ²	Falconry Estimated Annual Take	Comments
		Legal	Policy	None			
Area 1	ID		x		none- R, 10-NR	6	No quota for resident take; quota of 10 birds for non-resident take.
	MT		x		none	5	
	ND			x	none	0	No breeding records for state.
Area 2	CO			x	none	6-10	
	KS			x	none	0	No breeding records for state. Infrequent winter visitor.
	NE			x	none	0	No confirmed breeding records; fall and spring migrant. No quota but take limited to immature birds.
	SD			x	none	1-2	
	WY		x		70	8	
Area 3	AZ		x		3	1-2	Moratorium on take 1991-1995.
	NM			x	6	0	Moratorium on take of nestlings 1991-present. Prior to 1991 annual take was 1.3 birds
	OK			x	none	0	No breeding records for state. Rare winter visitor.
	TX			x	none	0	No breeding records for state. Winter visitor only.
Area 4	NV			x	10- R, 3-NR	5	Falconry quota applies only to nestlings; no quota on immature birds. Annual take has ranged from 1-7 birds.
	UT		x		20	4	Falconry quota applies only to nestlings
Area 5	CA		x		none	11	Take prohibited in Tahoe Basin.
Area 6	OR		x		12	1	
	WA		x		none	6	

¹ State Status: Legal- listed as a threatened or endangered species under state legislation
Policy- recognized in policy as a sensitive, protected, priority or species of concern
None- not listed under state legislation and not recognized as a sensitive, protected, priority or species of concern in state policy

² Falconry Quota: R- resident, NR- nonresident

State Forest Practice Rules and Management Policies for Private and State-Administered Lands

Overview

Of the 17 states in the review area, 12 states manage forested lands, ranging from 13,300 acres (ND) to 2,100,000 acres (WA). Ten of these states administer, or believe they likely administer, some goshawk breeding habitat. Available estimates ranged from approximately 6000 acres (AZ) to 1,150,000 acres (WA), however most states could not estimate the proportion of forested lands that might provide goshawk habitat. Only two states (OR, CA) currently have policies or regulations that apply specifically to management of goshawk habitat. A third state (CO) is developing a management plan for one state forest that will include management guidelines for goshawk habitat. Only these three states (OR, CA, CO) have conducted at least partial surveys for goshawks on state-administered lands. A fourth state (NM) is preparing a plan to inventory resources on state lands and proposes to survey for goshawks.

Northern Assessment Area - Area 1

Idaho

The Idaho Department of Lands manages approximately 780,000 acres of commercial forest lands (Table 47). Goshawks are known to be present on state lands however, no systematic surveys have been conducted. The goshawk is designated as a “species of special concern” by the Idaho Department of Fish and Game however, no specific protection is provided under this classification. No rules or optional management guidelines address northern goshawk habitat on state lands. Idaho’s Forest Practices Act does require that “special consideration [be given] to preserving any critical wildlife or aquatic habitat” (rule 030.08.b). Idaho Department of Lands internal policy recommends that Idaho Fish and Game and the Fish and Wildlife Service be contacted before management activities occur within habitat of species of special concern.

Montana

The Montana Department of Natural Resources and Conservation manages approximately 622,000 acres of forested trust land. A few goshawk nest sites have been documented on state lands however no systematic inventories have been conducted. Known nest sites have been located during timber sale field work. Statewide, breeding goshawks have been documented in 50% of the state’s 47 latilong blocks (degree blocks) with others suspected.

No regulatory mechanisms or optional management guidelines have been established to protect northern goshawk habitat on state-managed lands. A 1996 State Forest Land Management Plan governs current forest management operations. No specific guidance is provided for goshawk habitat, however, state lands are being managed for a “desired future condition characterized by the proportion and distribution of forest types and structures historically present on the landscape.” The exception is that old-growth forests would be maintained at no less than one-half the historical proportion of any given forest type. A “fine filter” species specific approach would address habitat needs for threatened, endangered and sensitive species should they inhabit state lands.

North Dakota

The North Dakota Forest Service manages approximately 13,300 acres of forest lands distributed

among five forests, three of which are located west of the 100th meridian. There are no records of goshawks nesting in the state and no surveys have been conducted. However, potential habitat may be present in the north central portion of the state.

Rocky Mountain Assessment Area - Area 2

Colorado

The Colorado State Forest Service manages approximately 300,000 acres of forested state trust lands (Table 47). Goshawk surveys were conducted 1995-1997 on one administrative unit, the 71,000 acre Colorado State Forest and Park. Seven breeding pairs were located (R. Cavallaro, independent contractor, pers. comm.). A 10 year management plan for this area is currently under revision and will include Best Management Practices for northern goshawk habitat (based on Reynolds et al. 1992).

Kansas

No information was received from the Kansas State Forest Service. However, Kansas Department of Fish and Game biologist Jerry Horak (pers. comm.) indicated goshawks are infrequent visitors to the state and no nests have been recorded in Kansas.

Nebraska

No information was received from the Nebraska Forest Service. The Nebraska Game and Parks Commission (M. Fritz, pers. comm.) indicated the goshawk is a fall and spring migrant nearly statewide. There are no confirmed breeding records in the state, however, there have been several breeding season sightings reported from one locale on the Nebraska National Forest (Pine Ridge Ranger District). Nebraska state lands are not expected to provide goshawk breeding habitat and therefore regulations would not apply.

South Dakota

The South Dakota Department of Agriculture, Division of Resource Conservation and Forestry does not manage any state forest lands. Most state lands were consolidated into Custer State Park (76,000 acres) and managed by the Department of Game, Fish and Parks. One active territory was located in 1997 on the boundary between the Park and the Black Hills National Forest. No surveys have been conducted on state park lands and no special regulations protecting goshawk habitat on non-federal lands exist.

Wyoming

The Wyoming Office of State Lands and Investments, Forestry Division, manages 200,000 acres of forested lands. Approximately 160,000 acres are considered commercial lands and 90,000 are actively managed. No surveys have been conducted on state lands although one inactive goshawk nest was reported. No specific rules exist for protection of goshawk habitat.

Southwest Assessment Area - Area 3

Arizona

The Arizona State Land Department manages approximately 35,000 acres of forested lands (Table 47). State lands in Arizona are generally part of a checkerboard pattern of state and private sections. Approximately 6000 acres (discontinuous) located in northern Arizona include

late successional ponderosa pine forests and are suitable or capable of providing goshawk nesting habitat. No surveys are conducted for northern goshawks and no nests have been located. However, based on incidental sightings, up to three breeding pairs may occur on state lands.

No regulatory mechanisms or management guidelines are in place to protect northern goshawk habitat on state-managed lands. A forest management plan sets objectives for multiple use and uneven-aged management on state lands. The plan indicates Federally listed species and state species of special concern will be considered in project planning. Surveys for Federally listed species (e.g., Mexican spotted owl) are conducted on state lands and habitat is protected in consultation with the USFWS (K. Pajkos, AZ State Land Department, pers. comm).

New Mexico

The New Mexico Land Office manages approximately 90,000 acres of forested lands which may provide goshawk nesting habitat. No surveys are conducted for northern goshawks and no nests have been located.

No regulatory mechanisms or management guidelines are in place to protect northern goshawk habitat on state-managed lands. The New Mexico Land Office is currently developing a plan to inventory resources on state lands. This plan will propose surveys for Federally listed and proposed for listing wildlife species and sensitive wildlife such as the northern goshawk (B. Jenks, NM Land Office, pers. comm.). The New Mexico Forestry Division works with private landowners to develop Woodland and Forest Stewardship Management Plans. These plans, however, do not directly address northern goshawks and their habitat and there is no information on the amount of available habitat on private lands (K. Paul, NM Energy, Minerals & Natural Resources Department, pers. comm.).

Oklahoma

The Oklahoma Department of Agriculture, Forestry Division manages approximately 40 acres of ponderosa pine forest mixed with upland oak, pinyon and juniper, as well as 35,000 acres of pinyon-juniper woodland in western Oklahoma. Ponderosa pine tree size is small and crowns are open. This area is not expected to support goshawks. Due to low rainfall, adverse growing conditions and land use, the woodland sites probably do not currently meet goshawk habitat standards and are not considered capable of supporting goshawk habitat. Therefore, no surveys have been conducted and no regulations apply to the protection of goshawk habitat on state lands (K. Atkinson, OK Forestry Division, pers. comm.).

Texas

No information was received from the Texas Forest Service, however, Texas Parks and Wildlife Department (C. Farquhar, pers. comm.) indicated that the only goshawk records for the state are from winter months. State-administered lands do not provide goshawk breeding habitat and therefore no regulations apply to the protection of goshawk habitat.

Intermountain Assessment Area - Area 4

Nevada

Nevada has no state forests and state lands are comprised of lower elevation habitats not likely to provide goshawk nesting habitat (Table 47). Therefore, no surveys have been conducted and no

regulations apply to the protection of goshawk habitat on state lands.

Utah

The Utah Division of Lands and Forestry (Ed Storey, pers. comm.) only manages lower elevation riparian and desert habitats. Therefore, no surveys have been conducted and no regulations apply to the protection of goshawk habitat on state lands.

Pacific Southwest Assessment Area - Area 5

California

California Department of Forestry manages approximately 70,000 acres of forest lands in five state forests. Several of the forests have been partially surveyed for goshawks, and a few goshawk nests have been located. California Forest Practices Rules (Title 14, California Code of Regulations, Chapters 4 and 4.5, Section 919.3) apply to all Timber Harvest Plans on State and private forest lands. For active goshawk nest sites (not inactive or alternates), a minimum buffer zone of 5 acres is established. This buffer may be increased up to 20 acres with written justification. Thinning, salvage and selective harvest is allowed in the buffer outside of a “critical” (nesting) period of March 15 through August 15.

Pacific Northwest Assessment Area - Area 6

Oregon

State forest lands in Oregon are managed by several agencies including the Division of State Lands, Department of Forestry, Parks and Recreation Department and Oregon Department of Fish and Wildlife. While forested state lands are scattered throughout Oregon, most are located in western Oregon and are managed by the Oregon Dept. of Forestry (approximately 779,000 acres). Significant blocks of state forest lands are located on the Oregon Coast Range, west slope of the Cascade Mountains and the southeast slope of the Cascades.

Based on historical records and extensive raptor surveys conducted over the past 25 years, the Oregon Coast Range is generally considered unsuitable for goshawks. However, state lands in western Oregon have not been surveyed specifically for goshawks. The Oregon Department of Forestry and Division of State Lands have completed a Habitat Conservation Plan (HCP) for spotted owls on the Elliott State Forest (93,000 ac) in the southern coast range, however, goshawks are not known to be present. New forest plans and an HCP are being developed for all western Oregon state forests (634,000 ac) and have the goals of maintaining older-forest conditions across the landscape. Less than 1% of state forest lands within the HCP area are currently considered mature or old-growth forest.

The Oregon Department of Forestry has completed a Forest Plan for the Sun Pass Forest on the southeast slopes of the Oregon Cascades (approximately 48,000 acres). Habitat is being managed to maintain several potential nesting areas and mature forest conditions in areas between adjacent Forest Service lands and Crater Lake National Park. Goshawk surveys detected one pair in 1997. Additional surveys will be conducted in 1998 (C. Smith, pers. comm.).

No regulatory mechanisms or management guidelines exist in Oregon except those for the Sun Pass Forest referenced above. Oregon has a state Forest Practices Act that applies to all state and

private forest lands. Special rules have been developed for protecting site specific habitat for sensitive species (e.g., spotted owls, bald eagles) however none exist for the goshawk.

Washington

The Washington Department of Natural Resources (DNR) manages approximately 2.1 million acres of forested state lands in western and eastern Washington. Under a 1997 spotted owl HCP for western Washington state lands, DNR manages an estimated 1,150,000 acres of forest lands capable of supporting goshawk nesting habitat. Currently about 512,000 acres of those lands may provide goshawk nesting habitat and little change is expected to occur in the overall amount within the next 30 years. An additional 72,000 acres of uninventoried lands in western Washington are considered likely goshawk habitat. The HCP does not cover eastern Washington state lands however, other land and species management plans (e.g., Loomis Landscape Plan and Lynx Management Plan) provide direction such that an estimated 19,000 acres of forest lands will be managed consistent with potential goshawk nesting habitat. Other uninventoried state forest lands are also considered likely goshawk habitat. There are currently no forest practice rules in Washington that apply specifically to the goshawk.

Table 47. Northern goshawk habitat status and protection on state-administered forested lands in the petitioned area, by Assessment Area and State.

Assessment Area	State	Estimated Forested Acres	Breeding goshawks or nesting habitat?	Goshawk Habitat Protection?
Area 1	ID	780,000	yes	no
	MT	622,000	yes	no
	ND	13,300	unknown	no
Area 2	CO	300,000	yes	no
	KS	0	no	n/a
	NE	0	no	n/a
	SD	76,000	yes	no
	WY	200,000	yes	no
Area 3	AZ	35,000	yes	no
	NM	90,000	likely	no
	OK	35,040	unlikely	no
	TX	0	no	n/a
Area 4	NV	0	no	n/a
	UT	0	no	n/a
Area 5	CA	70,000	yes	yes
Area 6	OR	779,000	likely	yes
	WA	2,100,000	yes	no

Points Raised by the Petitioners

The majority of the petitioners' discussion on the inadequacy of regulatory mechanisms centers on allegations of failure to obey existing laws such as the Act, NMFA and NEPA. The petitioners further allege fraud and unprofessionalism in land-management agencies. However, the allegations raised are inadequately supported, and it is beyond the scope of this finding to address these issues.

Conclusions

Based on information reviewed, the Service does not believe falconry to be a significant factor affecting the long-term trend of goshawks within the petitioned area. The overall take allowed is minimal and well regulated by the states. Regarding state regulations and policies, the Service finds that for most states in the petitioned area, state lands constitute a relatively small amount of overall goshawk habitat. While only two of the states within the review area have regulations that specifically address goshawk management, others are beginning to give the goshawk additional attention. Additionally, goshawks may benefit from regulations and management implemented by the states for the northern spotted owl, California spotted owl, and Mexican spotted owl. Goshawks continue to be wide-spread throughout the petitioned area, so at this time, the Service does not find information that would indicate state regulatory mechanisms, or lack thereof, are significantly affecting goshawk populations within the petitioned area.

E. Other Natural or Manmade Factors Affecting its Continued Existence

Disturbance

Disturbance is another factor that may negatively affect goshawks. Disturbances associated with timber practices can cause nest failure, especially during incubation (Anonymous 1989, Boal and Mannan 1994, Squires and Reynolds 1997). Camping has also been determined to cause nest failure (Speiser 1992). Disturbances associated with research are usually of short duration, and apparently have little impact on nesting birds. Observations of nests for short periods of time following hatching of young is not documented to cause desertion, and nor does trapping of adults for banding or attaching radio transmitters during nesting (Austin 1993, Squires and Reynolds 1997). In general, the Service finds no documented evidence that disturbance is a significant factor affecting goshawk populations in the petitioned area.

Pesticides and Other Contaminants

In the early 1970's, pesticide levels in goshawks in the United States were low (Snyder et al. 1973), but were high in other raptors such a peregrine falcons and osprey (Squires and Reynolds 1997). Eggshell thinning has not been a problem for most populations, although California eggshells (weight and thickness index) pre-1947 (pre-DDT) to 1947-1964 (DDT in use) declined 8-12% (Anderson and Hickey 1972). In Illinois, wintering goshawks during the 1972-73 invasion year contained less organochlorine and PCB residues than did other raptors (Havera and Duzan 1986). These birds were probably from nonagricultural northern forests. In general, the Service finds no documented evidence that pesticides and other contaminants significantly affect goshawk populations in the review area.

FINDING

The Act requires the Service to make a determination regarding listing solely on the basis of the best scientific and commercial data available after conducting a review of the status of the species.

Based on the best available information, the Service did not find evidence of a declining population trend for goshawks. While the Service did find that forest management (e.g., timber harvest and fire suppression) has changed the vegetation characteristics throughout much of the western United States, the available data indicate that goshawks remain widely distributed throughout the western United States. Approximately 75% of the goshawk territories reported to and analyzed by the Service (n=2,729) were discovered in the past 10 years. The current distribution approximates the historical distribution of nesting goshawks, and there is no evidence of any significant areas of extirpation. The Service finds no documented evidence that a significant curtailment of the species' habitat or range is occurring.

The information presented in the petition relies largely on a contention that the northern goshawk is dependent on large, unbroken tracts of "old-growth" and mature forest. However, neither the petition nor other information available to the Service supports this claim. The Service found that while goshawks frequently use stands of old-growth and mature forest as an important component of its nesting habitat, overall the species appears to be a forest habitat generalist in terms of the variety and ages of forest types it uses to meet its life history requirements; goshawks use patches of mature habitat to meet nesting requirements within a mosaic of habitats in different age classes.

Therefore, the Service finds that listing the northern goshawk in the contiguous United States west of the 100th meridian is not warranted because available information does not indicate that this population is in danger of extinction or likely to become so in the foreseeable future.

A draft notice announcing this finding is attached for your review and publication in the *Federal Register*. Petitioners will be notified of this finding upon its publication in the *Federal Register*. If you have questions or require further information, please contact Karla Kramer at 503-231-6131 or Monty Knudsen at 503-808-2565.

Literature Cited

A complete list of the literature cited in this finding is available upon request from the Service's Office of Technical Support in Portland at 503-808-2565.

Attachments

Approval:  Disapproval: _____
Date: 6/22/98 Date: _____